Investigating ways of improving psychosocial recovery from negative symptoms: the role of metacognition

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Abstract

Introduction

Negative symptoms represent deficits of experience: reduced experiences of pleasure, social engagement and motivation, and expressive deficits: reduced affective expression through voice, facial expressions and gestures. These difficulties are common and often persistent in people who experience psychosis. They impact substantially on quality of life and functional outcomes, meaning more precise treatment targets are required. Neurocognitive deficits and cognitive biases have been associated with negative symptoms, but treatments targeting these mechanisms show limited success. Metacognition, the ability to make sense of self-referential experience and the minds of others, which has been shown to explain a large amount of the variance in negative symptoms, may be a more effective treatment target. This thesis aimed to examine the degree of association between negative symptoms, metacognition and related constructs, and methodological factors which impacting on these associations. The level of specificity required to identify meaningful associations when exploring these multi-factorial constructs was assessed to be able to identify avenues for clinical change.

Methods

Four studies were conducted. A systematic review (Chapter 3) summarised existing literature reporting relationships between metacognition and negative symptoms, and the risk of bias. Chapter 4 used data derived from the systematic search in an Individual Participant Data Meta-Analysis (IPDMA) of the relationship between metacognition and negative symptoms at their summed and sub-category level. Secondary data analysis (Chapter 5) compared levels of negative symptoms in individuals with psychosis dependant on levels of metacognition and attachment classification and reflective function (the ability to understand self and others in affect-laden interpersonal contexts). Path models were also used to explore how metacognition, reflective function and attachment classification were related to each other. Chapter 6 used two novel samples to explore the relationship between negative symptoms and constructs which emerged as significant in the previous analyses (metacognition and attachment

classification) and emotion regulation. Sensitivity analyses were conducted throughout to explore the reliability of these findings.

Results

Few previous studies have focused on examining the relationship between metacognition and negative symptoms; these associations are often reported as an incidental finding. Existing data are at risk of bias as unique participants often contribute to several reported analyses which is not transparently reported. IPDMA reveals that, similar to published reports, there is an inverse association between negative symptoms and metacognition, but contrary to expectations, the association between total negative symptoms and metacognition is stronger than any one relationship between negative symptom subtypes and metacognitive subdomains. Contrastingly, in Chapters 5 and 6, similar-strength associations are seen between domains of metacognition and experiential and expressive deficits as well as total negative symptoms. Avoidant attachment (reflecting a working model which downplays relationships), and emotion regulation strategies associated with reduced affective expression, support seeking, and cognitive reappraisal were also associated with increased levels of negative symptoms. Reflective functioning was not strongly associated with negative symptoms despite being correlated with metacognition and avoidant attachment.

Discussion

Across all chapters, negative symptoms were inversely associated with metacognition. However, persons with severe negative symptoms and greater metacognitive dysfunction were not as well represented in these samples compared to those with lower levels of metacognitive dysfunction and negative symptoms. These sampling issues potentially obscure cut-off effects or non-linear relationships, whereby individuals with severe negative symptoms experience disproportionately greater metacognitive deficits than individuals with less severe negative symptoms. Negative symptoms were also associated with several deactivation strategies (avoidant attachment, and expressive suppression) and decreased use of strategies requiring social engagement or cognitive reappraisal. Associations between attachment, metacognition and

emotion regulation suggest some possibility that these constructs exert top-down influence on the others respectively. Overall, there is moderate evidence supporting the proposition that metacognition is one of several important treatment targets for negative symptoms. This justifies the need for further research in samples with severe negative symptoms and evaluation of treatment strategies to enhance metacognition for persons with negative symptoms.

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Author's declaration

I declare that I am the sole author of this thesis, except where the assistance of others has been acknowledged. The work in this thesis has not been submitted in any form for another degree or professional qualification.

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Definitions of abbreviations

AAI - Adult Attachment Interview
ACE - Adverse Childhood Experiences
ACT - Assertive Community Treatment
AIC - Akaike Information Criterion
ANCOVA - ANalysis Of CO-VAriance
ANOVA - ANalysis Of VAriance
BAI - Beck Anxiety Inventory
BCIS - Beck Cognitive Insight Scale
BDI - Beck Depresion Inventory
BELLCOG - Bell et al. (1994) Cognitive disorganisation subscale
BLERT - Bell-Lysaker Emotion Recognition Task
BPD - Borderline Personality Disorder
BPRS - Brief Psychiatric Rating Scale
BPRS-E - Brief Psychiatric Rating Scale - Extended
C - Covariance
CAINS - Clinical Assessment Interview for Negative Symptoms
CBSST - Cognitive Behavioural Social Skills Training
CBT - Cognitive Behavioural Therapy
CBT-n - CBT for Negative symptoms
CECAQ - Childhood Experience of Care and Abuse Questionnaire
CFI - Comparative Fit Index
CGI -Clinical Global Impression
CI - Confidence Interval
Confint: Confidence Interval
Cov - Covariance
CPT-II - Conners' Continuous Performance Test II
CR - Cognitive Remediation
CTQ - Childhood Trauma Quesionnaire
A - Avoidant
DF - Degrees of Freedom
DKEFS - Delis-Kaplan Executive Function System
DMP - Data Management Plan
DMT - Dance Movement Therapy
DPIA - Data Protection Impact Assessment
DSM-IV(-TR) - Diagnostic and Statistical Manual 4th edition(- Text Revised)
DUP - Duration of Untreated Psychosis
DV - Dependent Variable
EEG - Electro-encephalogram
EI - Early Intervention
ER - Emotion Regulation
ERQ - Emotion Regulation Questionnaire
ES - Expressive Suppression
ESM - Experience Sampling Method
FEP - First Episode Psychosis
FS - Factor Structure
G5 - Mannerisms and posturing
G7 - Motor retardation
G8 - Uncooperativeness
G11 - Poor attention
G13 - Disturbance of Volition

G13 - Disturbance of volition
G14 - Poor impulse control
G15 - Preoccupation
G16 - Active social avoidance
GAF - Global Assessment of Functioning scale
HiTOP - Hierarchical Taxonomy of Psychopathology
HVLT - Hopkins Verbal Learning Test
ICD - International Classification of Diseases
IPD - Individual Participant Data
IPDMA - Individual Participant Data Meta-Analysis
IPII - Indiana Psychiatric Illness Interview
IQ - Intelligence Quotient
IRI - Interpersonal Reactivity Index
ISMIS - Internalised Stigma of Mental Illness Scale
MAI - Metacognition Assessment Interview
MANSA - Manchester Short Assessment of Quality of Life
MAS-A - Metacognition Assessment Scale - Adapted
MAS-R - Metacognition Assessment Scale - Revised
MATRICS - Measurement and Treatment Research to Improve Cognition in Schizophrenia
MBT-p - Mentalisation Based Treatment for psychosis
MCCB - MATRICS Consensus Cognitive Battery
MEP - Multiple Episodes of Psychosis
MERIT - MEtacognitive and Reflection and Insight Therapy
MIT-p - Metacognitive Interpersonal Therapy for psychosis
MLR - Maximum Likelihood Robust
MOSST - Metacognition-Oriented Social Skills Training
mPFC - medial Pre-Frontal Cortex
MSAS - Metacognition Self-Assessment Scale
MSCEIT - Mayor-Salovey-Caruso Emotional Intelligence Test
MVPA - Moderate to Vigorous Physical Activity
N1 -Blunted affect
N2 - Emotional withdrawal
N3 - Poor rapport
N4 - Passive/apathetic social withdrawal
N5 - Difficulty in abstract thinking
N6 - Alogia
N6 - Lack of spontaneity and flow of conversation
N7 - Stereotyped thinking
NHS - National Health Service
NICE - National Institute for Health and Care Excellence
NICR - Narrative Interview for Compassion and Recovery
NIMH - National Institute of Mental Health
NoS - Non-Significant
NS - Negative Symptoms
P - Path
Pr - Preoccupied
P2(-) - Conceptual disorganisation
PANSS - Positive and Negative Syndrome Scale
PANSS-BNS - Positive and Negative Syndrome Scale (Bell et al., 1994 factor structure) - Negative Symptom subscale
PANSS-NS - Positive and Negative Syndrome Scale - Negative Symptoms

PANSS-ONS - Positive and Negative Syndrome Scale (Original factor structure) - Negative Symptom subscale
PANSS-VDGNS - Positive and Negative Syndrome Scale (Van der Gaag et al., 1994 factor structure) - Negative Symptom subscale
PAS - Premorbid Adjustment Scale
PCL-R - Hare Psychopathy Checklist – Revised
PECOS - Participants, Exposure, Comparator(s), Outcome(s) and Study design
PEPS - Positive Emotions Program for Schizophrenia
PRISMA - Preferred Reporting Items for Systematic Review and Meta-Analysis
PRISMA-IPD - Preferred Reporting Items for Systematic Review and Meta-Analysis for Individual Participant Data
PRISMA-P - Preferred Reporting Items for Systematic review and Meta-Analysis Protocols
PSP - Personal and Social Performance Scale
PTSR - Possible Total Score Range
QLS(-MI) - Quality of Life Scale(- Motivation Index)
QOL - Quality of Life scale
QUIPS - Quality in Prognosis Studies
RAS - Recovery Assessment Scale
RCT - Randomised Controlled Trial
RDoC - Research Domain Critera
REML - REstricted Maximum Likelihoo
REQ - Regulation of Emotions Questionnaire
RF - Reflective Functioning
RMSEA - Root Mean Square Error of Approximation
RSES - Rosenberg Self-Esteem Scale
RSS - Reappraisal and Support Seeking
Se - Secure
S - Significant
SANS - Scale for the Assessment of Negative Symptoms
SAP - Statistical Analysis Plan
SAT-MC - Social Attributions Test – Multiple Choice
SCID - Structured Clinical Interview for DSM
SCORS - Social Cognition and Object Relations Scale
SD - Standard Deviation
SDM - Self-Defining Memories
SE - Standard Error
SEngageT1/SEngageT2 – Service Engagement Time 1/2
SES - Service Engagement Scale
SIGN - Scottish Intercollegiate Guidelines Network
SR - Self-Reflectivity
SRMR - Standardised Root Mean Square Residual
SSDs - Schizophrenia Spectrum Disorders
SSR - Sample Size Range
SST - Social Skills Training
SUMD - Scale to Assess Unawareness of Mental Illness
SUR - Seemingly Unrelated Regression
T1 - Time 1
T2 - Time 2
TEPS - Temporal Experiences of Pleasure Scale
TMASA - Total Metacognition Assessment Scale - Adapted score
TMT - Trail Making Task
TNST1/TNST2 – Total Negative Symptoms Time 1/2

ToM - Theory of Mind
TUS - Time Use Survey
UOM - Understanding Others' Minds
UPSA - UCSD Performance-based Skills Assessment
VA - Veterans' Affairs
VDGCOG - Van der Gaag et al. (2006) Cognitive disorganisation subscale
WAIS - Wechsler Adult Intelligence Scale
WCST - Wisconsin Card Sorting Test
WMS - Wechsler Memory Scale

Chapter one: Introduction

1.1 Chapter overview

Experiences of psychosis are multifaceted, individuals experience a range of symptoms, including delusions and hallucinations (also known as positive symptoms; van Os & Reininghaus, 2016). Psychosis symptoms are most commonly experienced by individuals meeting diagnostic criteria for schizophrenia, which can also feature disorganised symptoms (e.g. disorganised thinking) and negative symptoms (e.g. apathy and blunted affect). Guloksuz and van Os (2018) argue that using this circumscribed and diagnostic focus on experiences of psychosis has limited understanding of the range of outcomes experienced, or the incidence of other individual symptoms and their severity. Additionally, lack of personalisation in treatment means that many individuals' needs remain unmet, including those arising from the experience of other symptoms (Maj et al., 2021). Negative symptoms are an important determinant of recovery and functioning but are relatively under-researched and poorly treated (Fusar-Poli et al., 2015).

Replacing psychiatric diagnoses with alternative classification systems (such as the Research Domain Criteria (RDoC; Insel et al., 2010) and Hierarchical Taxonomy of Psychopathology (HiTOP; Kotov et al., 2017) approaches) could increase emphasis on the factors which cause, maintain, and support amelioration of individual symptoms in experiences of psychosis (Lincoln & Peters, 2019). This chapter will introduce the concept of negative symptoms seen in people with psychosis and argue for the importance of identifying mechanistic treatment targets for negative symptoms as a means of improving psychosocial recovery. Current models of negative symptoms will be discussed and the potential role of neurocognitive, cognitive, and metacognitive mechanisms in their development and maintenance will be summarised.

Section one will attempt to situate the understanding of negative symptoms in this thesis in reference to the current literature; focusing on their relevance to other psychosis constructs, their categorisation, and the way these categories are currently understood. Section two will focus on mechanisms involved in the

development and maintenance of negative symptoms, addressing the neurocognitive, cognitive, and metacognitive psychological literature.

1.2 Section one: Conceptualising negative symptoms

1.2.1 Negative symptoms in psychosis

Negative symptoms are broadly defined as a deficit or absence of behaviours and/or psychological functioning (Kirkpatrick, 2014). They can be examined as a transdiagnostic construct, or in relation to other symptoms they commonly occur alongside (such as the positive symptoms of psychosis). Nolen-Hoeksema and Watkins (2011) argue there are likely unifying (or transdiagnostic) factors and independent causes (or divergent trajectories) implicated in the development and maintenance of any symptoms which commonly co-occur. Therefore, appropriate operationalisation of negative symptoms is required to differentiate the mechanisms involved in their development and maintenance which are unique or shared with other commonly co-occurring symptoms, to create more targeted treatments (Peralta & Cuesta, 2011; Strauss & Cohen, 2017).

Negative symptoms are regarded as a core feature of schizophrenia (Dollfus & Lyne, 2017). Schizophrenia can be understood as a psychiatric diagnosis constituting many of the symptoms mentioned above (most commonly stratified into positive, disorganised and negative symptoms; Parnas, 2011). Individuals with a schizophrenia diagnosis can present with entirely different symptoms (Tandon et al., 2013; Maj et al., 2021) and not all experiences of these symptoms meet diagnostic criteria for schizophrenia. Indeed, evidence has failed to indicate any one unifying set of experiences, symptoms, or biological changes which uniquely encapsulate or are pathognomonic to schizophrenia (Moncrieff & Middleton, 2015). Furthermore, across psychosis-specific diagnostic categories, negative symptoms appear phenomenologically similar (Shankman et al., 2014; Lambert et al., 2018).

However, evidence suggests that negative symptoms are most prevalent in persons diagnosed with schizophrenia versus any other psychosis-specific diagnosis (as much as 87% of participants with schizophrenia in one study; Lyne et al., 2012; and 72% for specific deficits of motivation in another; Lyne et al.,

2015). Negative symptoms are also commonly observed as many people experience psychosis over multiple episodes and transition through psychosis specific diagnoses (Lyne et al., 2015; Sauve et al., 2019). Negative symptoms are also experienced for much longer than positive symptoms, persisting even during periods of clinical stability (Buchanan, 2007). Therefore, tailored and appropriately targeted treatments must take account of specific symptoms, including negative symptoms (Guloksuz & van Os, 2018).

Historically, the ability to clearly operationalise positive symptoms, their high inter-rater reliability, and their role in predicting clinical outcomes has led to a greater focus on these in diagnostic and research endeavours compared to other symptoms (Tandon et al., 2013; Dollfus & Lyne, 2017). Yet negative symptoms in psychosis are consistently shown to be associated with relapse (Wunderink et al., 2020) and functioning difficulties (Ventura et al., 2015) in first episode psychosis and beyond. They exert influence on functional outcomes independent of positive symptoms (Brissos et al., 2011), and some studies suggest they explain differences in functioning and disability better than positive symptoms (Fervaha et al., 2014b; Barch et al., 2017). Negative symptoms have some of the most noticeable impacts on recovery from psychosis (Best et al., 2020). Perhaps as a result, their presence is associated with increases in healthcare costs and caregiver burden (Foussias et al., 2014; Rabinowitz et al., 2013); and they are also implicated in poor community functioning (Ahmed et al., 2016).

Some treatments developed to improve psychosis symptoms have demonstratble effectiveness (for example Cognitive Behavioural Therapy (CBT) for Psychosis; Burns et al., 2014; Turner et al., 2014). Yet, comparatively, the effectiveness of these treatments has not generalised to negative symptoms. It is likely that negative symptoms have been neglected in the development of treatment strategies (Elis et al., 2013; Lutgens et al., 2017a), explaining why existing treatments are of limited effectiveness (Riehle et al., 2020). Furthermore, different mechanisms may be associated with early development versus maintenance of negative symptoms, as might different protective and risk factors, indicating that treatment needs are likely to change over time (Lyne et al., 2018; Savill et al., 2015).

1.2.2 Categorising negative symptoms

The unclear definition of negative symptoms presents a significant challenge to targeted treatment. Negative symptoms have often been treated as a unitary construct, and only in recent decades has there been any consensus on which experiences constitute negative symptoms in psychosis (Kirkpatrick et al., 2006). Differentiating negative symptoms from other symptoms in psychosis has proven difficult given the overlap in their occurrence and impact on functioning, especially for cognitive and depressive symptoms (de Gracia Dominguez et al., 2009; Bagney et al., 2015; Krynicki et al., 2018). Resultantly, the most common measures of schizophrenia symptoms (the Positive and Negative Syndrome Scale (PANSS), Kay et al., 1987; the Scale for the Assessment of Negative Symptoms (SANS), Andreasen, 1989) originally included negative symptoms items that may be better conceptualised as cognitive disorganisation, such as inattentiveness and stereotyped thinking (Marder & Kirkpatrick, 2014). The current diagnostic manuals used to categorise schizophrenia symptoms also show variations in conceptualising negative symptoms (Maj et al., 2021).

For the purposes of this thesis negative symptoms are operationalised according to the National Institute of Mental Health (NIMH) consensus statement (Kirkpatrick et al., 2006), summarised in Table 1.1. While some of these symptoms (e.g. anhedonia) appear to overlap with aspects of depressive symptomatology (Krynicki et al., 2018), research demonstrates that negative symptoms in psychosis can be differentiated from symptoms in other diagnoses, despite some overlap in predisposing risk factors and outcomes (Bagney et al., 2015; Dollfus et al., 2015).

Table 1.1: Description of negative symptom subtypes

Negative symptom	Description
Blunted Affect	Decreased facial and vocal emotional expression and use of expressive gestures.
Alogia	Reduced speech quantity and spontaneous elaboration.
Anhedonia	Reduced experiences of pleasure.
Asociality	Reduced social motivation for forming and maintaining close relationships with others.
Avolition (used interchangeably with amotivation)	Reduced motivation to initiate and persist in goal direct activity.

Adapted from Marder and Galderisi (2017)

Negative symptoms can also be regarded as a primary problem (independent of other symptoms) or secondary (in response to other psychosis symptoms or environmental deprivation or resulting from medication or substance use) (Kirschner et al., 2017). Quantifying the prevalence of primary versus secondary negative symptoms is difficult, however it is postulated that both are common (Lyne et al., 2015). Despite secondary negative symptoms being uniquely associated with some mechanisms (i.e. the presence of other symptoms), both respond similarly to existing treatment, and difficulties effectively distinguishing primary and secondary negative symptoms through history taking limit utility of the construct (Aleman et al., 2017). Specifically, common negative symptoms measures have been criticised for failing to elicit subjective experience which may distinguish between primary and secondary causes of negative symptoms (Kaiser et al., 2017).

As an alternative, persistent negative symptoms are a common classification which avoids making causal interpretations about the origin of negative

symptoms (Galderisi et al., 2018). Definitions of persistent negative symptoms are not universal but are generally associated with a high severity of illness, poor psychosocial functioning and ongoing difficulty meeting functional goals (Bucci et al., 2020). Only some people with psychosis appear to have persistent negative symptoms (Chang et al., 2019b; Gee et al., 2016). Persistent negative symptoms are associated with predictors such as childhood trauma and pre-existing social functioning difficulties (Ruby et al., 2017; Ahmed et al., 2015), which also indicates this concept identifies a potential subgroup with unique experiences compared to those who do not experience persistent negative symptoms. While understanding the origin of negative symptoms can be informative for identifying a hierarchy of treatment targets (Galderisi et al., 2021a), it is likely that negative symptoms can still be improved by targeting the relevant mechanisms involved in their development and maintenance, regardless of their origin.

1.2.3 Recent advances in understanding negative symptoms

More precise assessment and characterisation of negative symptoms is needed if viable psychological treatment targets are to be identified. For example, close analysis of anhedonia in schizophrenia has shown that previous assumptions about patients' inability to experience pleasure have been incorrect (Strauss & Gold, 2012). Studies show that individuals with negative symptoms identify pleasurable stimuli in both laboratory and daily life settings in the moment, a capacity known as consummatory pleasure (Cohen & Minor, 2010; Gard et al., 2014a). However, the extension of this capacity to predicting pleasure for future events (anticipatory pleasure) has been shown to be impaired across studies (Frost & Strauss, 2016a; Painter & Kring, 2016). This suggests that anticipatory pleasure deficits (or anticipatory forecasting deficits, Frost & Strauss, 2016a) may more precisely convey the nature of these experiences.

Similarly, blunted affect has previously been conceptualised as a reduction in emotional experience, including emotion identification and interpretation (Andreasen, 1982; Lepage et al., 2011), yet studies demonstrate that persons with negative symptoms experience emotional arousal of similar valence and intensity to other people (Llerena et al., 2012c; Moran & Kring, 2017). Furthermore, persons with low levels of negative symptoms have been shown to

experience greater positive affect in reaction to pleasant events than control groups and persons with high levels of negative symptoms (Oorschot et al., 2013b), conceptualised as greater emotional instability. This highlights that blunted affect may be best captured by difficulties with emotional expression which may be independent from emotional experience, and that the subjective interpretation of decreased emotional expression is important (Kaiser et al., 2017).

More detailed observation of negative symptoms suggests that negative symptoms can be split into two conceptually and empirically separate domains (Kring et al., 2013). These are known as experiential deficits (comprising amotivation, asociality and anhedonia) and expressive deficits (including alogia and affective blunting). Conceptually this distinction reflects differences in symptoms which can be objectively observed (i.e. reduced vocalisation, facial expression and gestures are all observable), and subjective experience (i.e. the not directly observable experience of reduced pleasure or lack of interest in social activities). However, there has been limited theoretical focus on whether this distinction is underpinned by separate mechanistic processes and whether they originate from a unifying underlying difficulty is debated (Foussias & Remington, 2010; Kaiser et al., 2017).

Recent work suggests there are likely to be some shared mechanisms that lead to the development and maintenance of experiential and expressive deficits (Foussias et al., 2015). Although both experiential and expressive deficits can occur independently, they commonly co-occur (Strauss et al., 2013). They appear to be differentially related to longitudinal functioning, for example expressive deficits are most commonly associated with social cognition difficulties (Millan et al., 2014), and experiential deficits are associated with functional difficulties such as interpersonal relationship difficulties and difficulty maintaining personally meaningful roles (Fervaha et al., 2014c). They show differences in their longitudinal course with individuals demonstrating improvements in one type of negative symptom but not another (Galderisi et al., 2013).

Findings around the association between experiential and expressive deficits and cognitive abilities are inconsistent, with measurement difficulties around

negative symptoms and their correlates being a potential source of heterogeneity (Lim et al., 2016; Liemburg et al., 2020; Hartmann-Riemer et al., 2015). Variation in the prevalence and duration of negative symptoms could be an additional confound here: expressive negative symptoms are highly prevalent in persons with persistent negative symptoms (Galderisi et al., 2013), while they are not as prevalent in persons with first episode psychosis (Lyne et al., 2015). Expressive deficits are also shown to be associated with functioning when in individuals experiencing a longer duration of illness (Liemburg et al., 2020) and studies indicate that expressive deficits may be persistent but only for a subgroup of people (Stiekema et al., 2018a). Further research is required to understand whether these differences across subgroups arise through illness chronicity or some other mechanism (e.g. cumulative adversities impacting on the severity of symptoms).

Furthermore, it is still unclear what level of symptom differentiation is required when distinguishing negative symptoms; some researchers argue for a five-factor structure based on factor analyses of both traditional measures of negative symptoms (Chang et al., 2021; Strauss et al., 2019a; Strauss et al., 2019b) and more recent negative symptom measures (Ahmed et al., 2019). Therefore, our current understanding of factors leading to development and maintenance of negative symptoms is limited and current categorisation methods do not yet determine a personalised and precise understanding of negative symptoms at the subsymptom level. This introduction will critically examine how individual negative symptoms are conceptualised within the two-factor structure (while discussing unique symptom components) and implications for understanding negative symptom development and maintenance.

1.2.4 Mechanisms of experiential and expressive deficits

Researchers continue to question whether individual negative symptoms are causally related to each other, and amotivation is argued to be a central mechanistic pathway to development of all negative symptoms, with the impact of amotivation on other experiential negative symptoms being most extensively studied (Foussias & Remington, 2010; Strauss et al., 2020). This makes sense as motivation appears a more influential construct, explaining 74% of the variance in functioning in one study (Foussias et al., 2011). Many researchers consider

capacities previously described as related to anhedonia or asociality as part of the multifaceted construct of motivation (Kring & Barch, 2014; Thonon et al., 2021). For example, asociality has been reconceptualised as social amotivation as opposed to reduction in social activity alone (Kirkpatrick et al., 2011; Messinger et al., 2011). A simple causal relationship is unlikely to explain all variance in negative symptoms, demonstrated by data where experiential negative symptoms are imperfectly correlated (Kring et al., 2013) and are often experienced exclusively and associated with unique, independent factors (Lincoln et al., 2011). For example, social cognition has been uniquely related to asociality (Kaiser et al., 2017). Therefore, while experiential negative symptoms may be closely related, they are also likely to vary somewhat independently.

Da Silva et al. (2017) argues that one of the reasons deficits in consummatory (in the moment) and anticipatory (thinking of the future) pleasure in persons with psychosis are not consistently replicated (Edwards et al., 2015b; Strauss et al., 2011c; Tremeau et al., 2010), is that hedonic deficits are more likely to be experienced by individuals who also experience difficulty with motivation, which is not true of all people experiencing negative symptoms. However, Gard et al. (2014a) found that persons with psychosis were more likely to have difficulties with planning and initiating effort-based behaviour rather than anticipating pleasure. Possibly then, some experiential deficits may be a precursor of others, for example, perhaps individuals must have low motivation to develop anhedonia.

In this sense, amotivation can also be considered as part of a hierarchy of sub-elements of negative symptoms, such that improvements in amotivation lead to improvement in the lower-order negative symptom constructs such as asociality and anhedonia (Strauss et al., 2021a). These views are consistent with neurocognitive models of motivational processes (Kring & Barch, 2014; Thonon et al., 2021) and data indicating that correcting for other negative symptoms reduces statistical significance of relationships between domains of negative symptoms and functioning (Liemburg et al., 2020).

In general, the understanding of factors leading to the development of expressive deficits is less clear, with experiential deficits receiving greater research attention in part due to their immediate relevance to functional

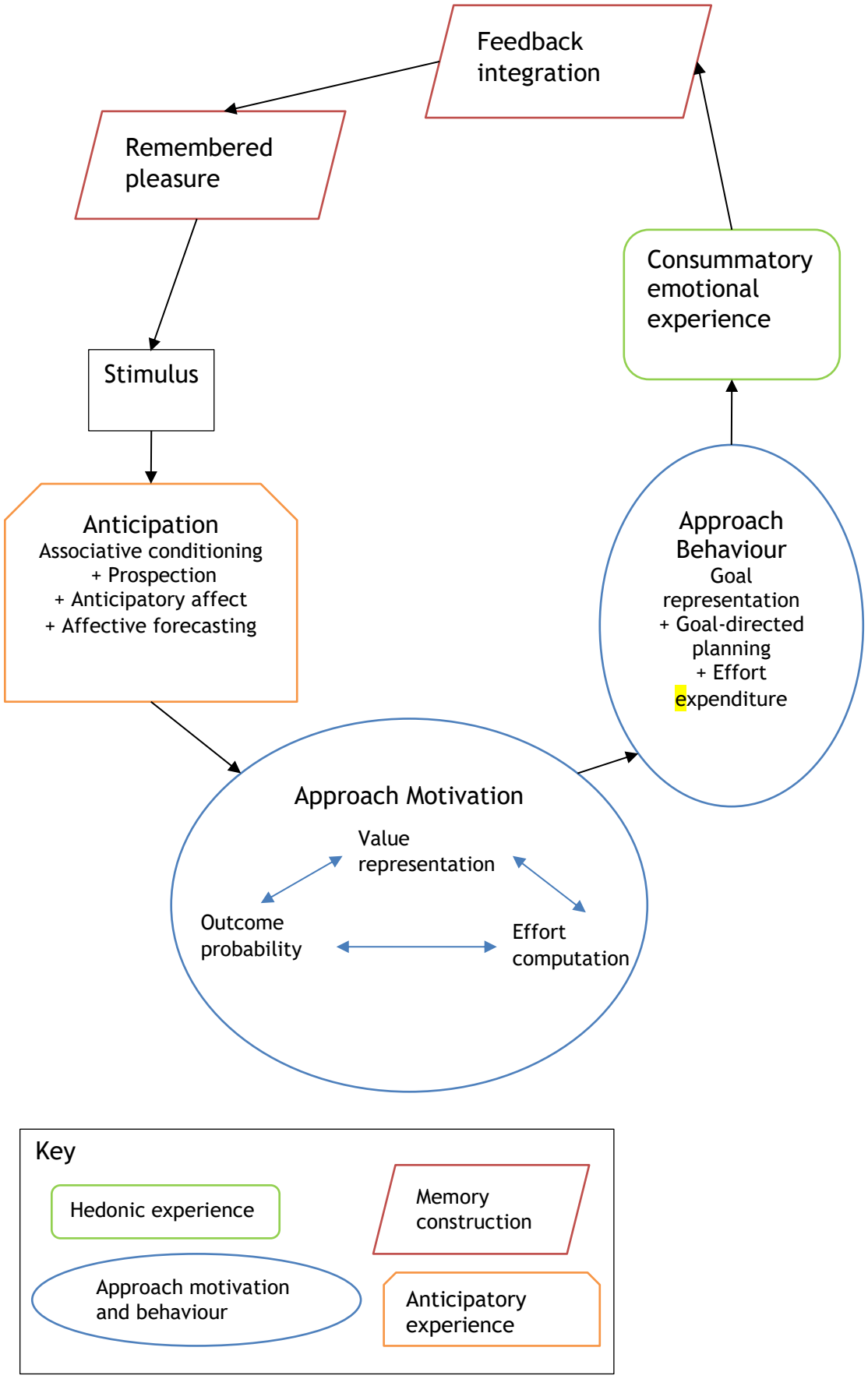
outcomes (Strauss et al., 2014). Expressive deficits have also been posited to impact functioning both independently and as a distal factor operating through experiential deficits (Chang et al., 2017a; Okada et al., 2020) perpetuating uncertainty around their independence from experiential deficits. However, Riehle et al. (2018) found that only individuals with high levels of expressive deficits were rated by a social interaction partner as having lower social performance. These individuals were also found to use significantly fewer positive facial expressions and were more likely to be rated less desirable for future social interaction, independent of experiential deficits. Executive function may be one mechanism which is disrupted in expressive negative symptoms but less so in experiential deficits (Jang et al., 2016; Sevy et al., 2020). Developing an understanding of how both deficit types are developed and maintained could be integral to understanding why some treatments appear to be effective for either experiential or expressive deficits but not the other subtype (Grant et al., 2012; Lincoln et al., 2017; Sevy et al., 2020). The remaining sections in this chapter will review models of the development and maintenance of negative symptoms and then their use in treatment.

1.3 Section two: Psychological processes implicated in negative symptom development and maintenance

1.3.1 Neurocognitive models

Kring and Barch (2014) developed a neurocognitive account of negative symptoms based on commonalities across existing research, with strong influence from the temporal experience of pleasure model (Kring & Caponigro, 2010). As described by Edwards et al. (2015a), the Kring and Barch (2014) model includes four main components: hedonic experience, anticipatory pleasure, approach motivation and behaviour, and memory construction. However, given the preceding discussion we argue that the anticipatory pleasure component can be decomposed further to consider additional cognitive processes, as mentioned in Frost and Strauss (2016b). These will be discussed in greater detail below and are summarised in Figure 1.1.

Figure 1.1: Model of key processes in anticipatory pleasure and motivation. Adapted from Kring and Barch (2014)



1.3.1.1 Hedonic experience:

As noted previously, anhedonia has more recently been conceptualised as difficulties with anticipatory pleasure rather than hedonic experience deficits. Strauss (2013a) attributes this to different cognitive capacities used in the processing of emotionally-laden information in the moment versus remembered and anticipated pleasure. However, as this section will show, findings around hedonic experience in psychosis are inconsistent (Mote & Fulford, 2020). For example, when using self-report data, as opposed to laboratory methods, a recent systematic review indicates that across the psychosis spectrum, consummatory pleasure is reduced compared to controls (Visser et al., 2020). Experimental data also suggests that individuals who experience negative symptoms are more likely to experience intense negative emotions and less positive emotions in social situations (McCarthy et al., 2016; Campellone & Kring, 2018; Campellone et al., 2018). Furthermore, people with negative symptoms are likely to express less desire to continue a positively toned social interaction (McCarthy et al., 2016; Campellone & Kring, 2018; Campellone et al., 2018).

Yet experience sampling methodology data are more mixed. Some studies report people with negative symptoms experience more day to day negative affect and restricted positive affect compared to control participants (Cho et al., 2017), and a preference to be alone in social situations (Oorschot et al., 2013a). Yet some of these studies also find persons with schizophrenia often report positive affect related to social experiences despite a preference to be alone (Oorschot et al., 2013a). However, as Mote and Fulford (2020) highlight, emotional experience is complex and likely to vary in different moments or situations. Additionally, individuals' preference to be alone may also be unrelated to their experience of pleasure in the moment. Additionally, differences in study methods may contribute to differences in consummatory pleasure deficits observed across groups and also raises questions about whether the ability to experience pleasure in the moment is affected by factors such as loneliness and social functioning difficulties for people with a schizophrenia diagnosis versus controls (Mote et al., 2019).

The ability to interpret social information (social cognition) may also affect hedonic experiences (Tso et al., 2010). Social cognition has also been shown to be poor in individuals with psychosis, including in the prodromal stage, suggesting this is a key factor in the development and maintenance of negative symptoms (MacBeth et al., 2014). Equally the ability to take pleasure from social events has also been correlated with reduced social skills, such as responding in an affiliative way and with content and expression that was appropriate to the task of getting to know another participant (Llerena et al., 2012b). It is unclear to what extent individuals rate social interactions negatively based on negative interpretations of the emotions and intentions of others and leading to difficulty feeling affiliated with others (Campellone et al., 2016a), or difficulty encoding, retaining and accessing positive social experiences thus priming the less-positive attributions given to new events or desire for them to end despite the positive affect experienced. Additionally, less-positive expectancies might be reinforced as a form of escape learning, as research shows that lower experiences of positive emotion are related to active social withdrawal (McCormick et al., 2012).

Fulford et al. (2018a) have suggested that heterogeneity in emotional experience may also be related to the type of reward experienced. Several studies use monetary gain as a typical reward where intact emotional experience in schizophrenia subgroups is observed. In comparison, studies measuring hedonic experience during social interactions (with either strangers or familiar others) are likely to have different reward values attached compared to monetary rewards and may be dependent on other variables such as social skills. Additionally, perceptions of trust may be impacted based on the type of social experience encountered, where cooperation may be more difficult for people with psychosis to identify versus deception (Gromann et al., 2013). In this way, several factors, including cognitive components, will influence hedonic experience.

1.3.1.2 Anticipatory pleasure

The previous section demonstrates how cognitive difficulties processing emotion-laden experience is likely to influence present moment emotions. Neurocognitive accounts of negative symptoms suggest that people with psychosis will

subsequently have difficulty anticipating pleasure for future scenarios (Kring & Barch, 2014) and evidence suggests these deficits are common in people with schizophrenia (Hallford & Sharma, 2019). However going beyond focusing solely on pleasure, Frost and Strauss (2016b) identify the need to develop better understanding of anticipation of negative and neutral experiences also. Indeed, some findings suggest individuals with psychosis report different anticipated emotions to controls, including less anticipated pleasure for social interactions (Engel et al., 2016), anticipated displeasure (Campellone & Kring, 2018; Campellone et al., 2018) and negative affect (Mote & Fulford, 2020). However, the evidence is not consistent across studies (Granholm et al., 2013; Oorschot et al., 2013a; Moran & Kring, 2017). Further research is therefore required to investigate other (i.e. non-positive) emotional experience, and factors influencing discrepancies in findings.

Frost and Strauss (2016b) suggest there are several cognitive components of anticipation that must be considered to understand which factors may result in discrepancies between anticipated and actual experience including:

- *Associative conditioning*

  Where individuals learn to pair a stimulus with reward associations. In schizophrenia research, some individuals with negative symptoms appear to have difficulty differentiating stimuli which they have previously been exposed to as associated with reward or loss (Gold et al., 2012).

- *Prospection*

  Which is the way in which individuals simulate hypothetical scenarios. It is likely that difficulties with associative conditioning will impact on an individuals' ability to use prospection for future scenarios. Raffard et al. (2013) found that individuals with negative symptoms had greater difficulty simulating both positive and negative experiences and could not form detailed representations of those hypothetical events.

- *Anticipatory affect and affective forecasting*

  Referring to the emotion experienced in the moment in relation to prospection (anticipatory affect) and the predictions individuals make about the emotions they are likely to feel in a prospective situation (affective forecasting). Little research has attempted to separate the two components. As mentioned at the beginning of this section, there is contradictory evidence around whether individuals with negative symptoms experience either anticipatory or consummatory affective deficits, with calls made to systematically synthesise the literature (Frost & Strauss, 2016b).

  Frost and Strauss (2016b) conducted a selective review of the literature and found more studies demonstrating no anticipatory affect deficits versus studies showing persons with psychosis responding differently to controls. This is also demonstrated in subsequent meta-analyses where no discrepancies were found in anticipatory versus consummatory pleasure capacities, or in control groups versus persons with psychosis (Visser et al., 2020; Mote & Fulford, 2020). While there are fewer discrepancies based on study design, measurement issues may contribute to these findings. The most common self-report measure of anticipatory affect is the Temporal Experiences of Pleasure Scale (TEPS; Gard et al., 2006), which may have inadequate criterion validity as it is unlikely to elicit true emotional experience, and more likely elicits judgements in response to hypothesised events (Frost & Strauss, 2016b). Furthermore, there is debate around whether consummatory and anticipatory pleasure deficits are stable constructs (Buck & Lysaker, 2013; Strauss et al., 2011c), and this would impact on reliability of these findings.

  To assess anticipatory affect further, two studies (Edwards et al., 2015b; Moran & Kring, 2017) use paradigms asking participants to rate affect when viewing a proxy for an emotionally valenced image from the International Affective Picture System (Lang et al., 1997). This included, for example, using a shape such as a triangle to cue an associated image of pleasant food or landscape or images designed to illicit negative affect such as snakes, or images of human injury (e.g. burns). Both studies

demonstrated a dampening of both positive and negative anticipatory affect in people with negative symptoms in comparison to healthy controls. However, in the latter study, individuals with negative symptoms experienced increased arousal to anticipatory stimuli (i.e. shapes representing both positive and negative valenced images). Edwards et al. (2015b) also showed that negative affect in the moment was high in the psychosis group, and this was likely to predict reductions in subsequent anticipatory positive affect.

Further research is required, particularly to understand the methodological differences that may have led to discrepancies across studies. For example, perhaps research using more experiential stimuli (i.e. assessing emotion before meeting a friend) versus imagery which might not necessarily induce experiential affect might significantly impact results. Moran and Kring (2017) posit that one factor influencing discrepancies across studies is the use of averages of valence ratings, which obscures important responses in relation to peak emotionally evocative stimuli which may indicate differences in ways of responding in people with negative symptoms versus controls. It is also worth noting that the (Edwards et al., 2015b) study used almost a third more images to generate average ratings, which might have influenced findings.

Given the multitude of cognitive processes involved, Fulford et al. (2018a) suggest the mechanisms of anticipatory affect discrepancies and affective forecasting difficulties are not straightforward. Several *automatic* cognitive processes (such as accessing memory, using executive function to manage competing information and process associations) could be disrupted in reward-based learning or anticipatory forecasting. Cumulatively, these may culminate in information processing deficits which lead to anticipatory pleasure deficits (Fortanati et al., 2015). Contrastingly, there are clear instances where these processes remain intact, and more *conscious* cognitive processes such as weighing up previous positive appraisals of social engagement could be responsible for anticipatory pleasure experiences or indeed deficits (Granholm et al., 2013).

This raises the possibility that these automatic and conscious cognitive processes are more disrupted for anticipated rewards versus loss expectancies (Mote & Fulford, 2020). This would explain Experience Sampling Method (ESM) study findings where individuals who experienced negative symptoms tended to underestimate the likelihood of pleasurable experiences, and overestimate the likelihood of negative emotional experiences compared to controls (Brenner & Ben-Zeev, 2014), in contrast to control subjects who typically over-anticipate experiences of pleasure (Strauss et al., 2013). Similarly, researchers have hypothesised that negative symptoms represent a protective mechanism to down-regulate the impact of otherwise distressing emotional experiences (Suslow et al., 2003). Most likely, different environmental and cognitive factors impact on the experience of anticipatory affect, and individuals should be exposed to a range of affect-laden situations in experimental studies to fully understand the mechanisms of different anticipatory affect. The likelihood of anticipatory affect deficits requires further review in which separation of these components outlined and methodologies used may be helpful.

1.3.1.3 Approach motivation and behaviour

So far, the deficits identified are pertinent to emotional experience either in the moment or when anticipating future events, and cognitive deficits related to simulating or interpreting affect-evoking situations resulting in reduced positive and increased negative affect. However, affective capacities alone are not sufficient to ensure an individual will be motivated to engage in social interactions or pursue specific goals. Indeed, some studies show that engagement in motivated behaviour often does not take place despite salient rewards being identified (Fervaha et al., 2013). In this sense, capacity for approach motivation, whereby an individual can consciously ascribe a desire to engage with a specific goal (a mental state), can be differentiated from the actual engagement with motivated behaviour (which is observable in the behaviour an individual pursues). However, similar to other areas of research in negative symptoms, approach motivation and behaviour are rarely distinguished in research, therefore both approach motivation and behaviour will be discussed here.

First, we will focus on the mechanisms identified in neurocognitive accounts of motivation.

- *Option generation*

  Generating goal-directed behavioural options is more difficult for persons experiencing psychosis in comparison to controls, and these difficulties are associated with levels of apathy (Hartmann et al., 2015). This process is salient for approach motivation which requires weighing up decision-relevant factors including effort allocation, outcome probability estimation, and value representation, with the latter being already identified as part of the affective forecasting process.

- *Loss aversion*

  Some studies (Strauss et al., 2011a; Gold et al., 2012) show people with negative symptoms are more likely to conserve energy as a behavioural response to stimuli or to engage in avoidance specific behaviours (i.e. learning outcomes associated with loss) but do not as readily learn optimal reward-seeking behaviours. This is not an issue solely of option generation, unless specific to reward seeking behaviour only. It may be that persons with negative symptoms act conservatively to avoid threat, such as monetary loss or social disapproval (Reddy et al., 2014). For example, some studies show people with psychosis do not demonstrate a preference for monetary rewards over loss avoidance (Waltz et al., 2018).

- *Effort expenditure avoidance*

  Alternatively, findings by Gold et al. (2013) suggest that although individuals with negative symptoms are capable of discriminating reward value similarly to controls, they engaged less in effortful behaviour overall, even for high value, high probability rewards. Similarly, Fervaha et al. (2013) found that individuals with high levels of experiential negative symptoms were unlikely to expend effort even when reward values were identified.

It is unclear whether effort expenditure and learning for loss aversion appears more intact because individuals have more difficulty with reward valuation versus loss avoidance computations (Treadway et al., 2015). There are also different results in effort-based decision making across studies (Culbreth et al., 2018), with methodological differences being one potential source of heterogeneity. Some studies (Fervaha et al., 2013; McCarthy et al., 2016) find individuals with negative symptoms are more likely to expend effort for low-likelihood rewards, indicating that it is ineffective effort/reward computation rather than an unwillingness to expend effort which might be prevalent. Gold et al. (2015) show that individuals with negative symptoms find it difficult to identify the difference in effort required when they explored tasks based on cognitive demand. Effort expenditure in response to uncertain rewards is also seen in non-patient social anhedonia samples McCarthy et al. (2015) and ESM data for people with psychosis (Gard et al., 2014a).

Overall, these findings suggest that cognitive deficits in either reward/effort/outcome computations, or all of these, likely impact on engagement in motivated behaviour. These deficits are linked to high levels of negative symptoms, (Chang et al., 2019a), although cognitive difficulties are also pertinent (Cooper et al., 2019). Deficits in reward-effort computations may also vary for loss versus reward computations which may be enacted by separate systems influenced by different mechanisms (Choi et al., 2012b). Reddy et al. (2014) found two different subgroups of persons with negative symptoms: one with difficulty with both behavioural activation and inhibition, and the other with only the former. Alternatively, it may be the cumulative impact of deficits such as an over-reliance on associative conditioning and an under-reliance on value representation compounds, leading to noticeable deficits (Hernaus et al., 2018; 2019). Therefore, certain capacities (including the ability to discriminate the probability of reward between stimuli) is likely to be protective in supporting individuals to update their value representations (Reddy et al., 2016b). More granular analyses of the experiences of people with negative symptoms in response to motivation-based decision making is therefore required to better understand these discrepancies and the characteristics associated with them.

1.3.1.4 Memory construction

Finally, for effective goal-directed decision making, individuals must be able to access and update their prior beliefs, as well as access episodic memories of similar experiences to that which is currently being simulated (Robinson & Clore, 2002). The studies outlined above indicating difficulties with reward learning suggest that accessing and updating information in memory may be impaired for people with negative symptoms. Studies demonstrate that individuals with higher levels of negative symptoms have greater difficulty holding reward representations in memory over time, with slightly less difficulty holding loss representations (Culbreth et al., 2021). Negative symptoms are a significant predictor of difficulties with remembering pleasure for emotional experiences also, even when positive emotions are identified in the moment (Weittenhiller et al., 2020). Interestingly, some studies have found that working memory improvements are not a significant mediator of improvements in negative symptoms (Cella et al., 2017b). However, working memory deficits are less strongly associated with negative symptoms compared with autobiographical memory retrieval difficulties (McLeod et al., 2006).

It is not entirely clear why different types of memory deficits might be more or less strongly related to negative symptoms. Strauss and Gold (2012) cite the emotion accessibility model by Robinson and Clore (2002) which posits that different types of information are accessed to make goal-directed judgements. Episodic memory gives the most direct information for assessing emotional experience, and generalised beliefs about the self and about situations are accessed when specific episodic memories are unavailable. Therefore, discrepancies between reports of current and non-current (i.e. retrospective, prospective) emotion in people with negative symptoms may be related to difficulties accessing direct episodic memories and increased reliance on more generalised beliefs. Strauss and Gold (2012) find that non-current affect estimations are more closely correlated than current and non-current affect representations which may signify this generalisation. Strauss (2013a) adds that individuals need sufficient working memory capacity to hold these representations in mind with enough detail to form salient emotional experiences. This may explain why working memory deficits are somewhat

correlated with negative symptoms but have not been shown to mediate the anticipatory affect of people with negative symptoms in previous studies.

In addition to the biases mentioned in the emotion accessibility model, Frost and Strauss (2016b) cite several recall biases which may impact on an individuals' emotional interpretation. They argue that unlike control groups, individuals with negative symptoms may not overestimate positive affect (optimism bias), meaning their expectations are based on the majority of life experiences which may be relatively mundane, thereby explaining anticipatory pleasure deficits. Similarly, individuals may have difficulty updating reward associations (Gold et al., 2012; Strauss et al., 2011b). This could explain findings where current emotion is less strongly linked to environmental cues i.e. current activities (Sanchez et al., 2014). However, studies with similar methodology also show this unrelated to working memory (Doll et al., 2014).

Overall, few of these assumptions have been empirically tested with adequate control of other influential factors (e.g. differences in reward representation or stimulus learning abilities). However, the limited evidence available is congruent with the possibility that episodic memory, particularly for self-referential information is impaired in people with negative symptoms (Harvey et al., 2011; Raffard et al., 2013). This could therefore be one of the core mechanisms impacting on abilities to predict future positive affect.

1.3.1.5 Summary

Overall, neurocognitive accounts of negative symptoms have implicated several factors in experiential deficits, particularly through recognising the complexity of emotional experience and that different information and cognitive processes will contribute to both current and non-current hedonic experience. The multitude of mechanisms discussed highlight that there may be many pathways to experiential deficits, which may explain the heterogeneity noted. However, the deficits discussed largely centre on using self-referential information to make decisions, particularly around experiences of reward, as well difficulty identifying pathways for action consistent with pursuing pleasurable experiences.

These neurocognitive accounts also leave several unanswered questions. For example, neurocognitive difficulties associated with expressive deficits are relatively unexplored. There are however theoretical assumptions regarding several of the mechanisms mentioned (e.g. managing working memory load; executive functioning deficits, Cohen et al., 2012; 2014). Furthermore, few studies differentiate the impact of these mechanisms on the development of experiential versus expressive deficits despite evidence suggesting neurocognitive functioning shows differing associations with experiential and expressive deficits (Hartmann-Riemer et al., 2015; Liemburg et al., 2020).

Additionally, current models of negative symptoms are heavily focused on mechanisms which operate at a relatively discrete level of mental operations. Discrete level functions are less complex, often automatic, and non-integrated cognitive capacities, in comparison to higher order cognitive capacities where several cognitive abilities are integrated to navigate complex decisions (Lysaker et al., 2013a). The studies cited use paradigms with a greater focus on binary decisions (i.e. to act or not) and manipulate only a few variables incorporated into reward/effort computations (i.e. decisions where only magnitude or reward frequency are manipulated). With the multitude of mechanisms discussed, it is unclear which variables are most influential in the development and maintenance of negative symptoms. Neither social cognition (including the judgements about another's knowledge or intentions) or neurocognition completely explain variance in negative symptoms in systematic reviews (Fett et al., 2011). Furthermore, some individual studies find that some cognitive processes might be linked but operate independently from each other in relation to negative symptoms (Culbreth et al., 2016). In exploratory analysis, studies have shown that discrete forms of neurocognition are less influential in predicting levels of negative symptoms than potentially more complex forms of cognition such as social cognition (Charernboon, 2020; Yolland et al., 2020). Overall, it is not clear how forms of higher-level cognition (such as cognitive bias) might influence these perceptions, particularly when applied to social rewards.

As Fulford et al. (2018a) mention, social situations are also more complex to navigate and involve additional skills including the ability to infer the intentions of others. Because of this, social rewards are inherently less certain and given

previous findings regarding preserved loss avoidance in many people with negative symptoms, it is possible that asociality is linked to difficulty using higher order cognitive capacities to process these situations, or the perception of threat, leading to withdrawal. Of studies investigating responses to social situations, impairments in reward valuation, effort expenditure and anticipated pleasure are all common, with effort conservation in social situations being often exhibited by people with negative symptoms (Campellone & Kring, 2018; Campellone et al., 2018). Furthermore, Culbreth et al. (2016) finds that when effort-cost computations are more complex (i.e. accounting for receipt of indirect rewards, or requiring identification of complex patterns) people with psychosis have more difficulty. The level of affect involved in socially-motivated decisions might also influence variability of responses to social situations (Catalano et al., 2018). Further research is required to understand how people with psychosis navigate complex decisions and generate reward representations when higher order capacities such as social cognition are required.

1.3.2 Cognitive models

Thonon et al. (2020) argues that neurocognitive accounts of negative symptoms provide detailed understanding of how individuals might experience motivation and affect in relation to a specific value or goal, but there are other cognitive variables which will also impact on an individuals' motivation. In addition to neurocognitive abilities, individuals also weigh their own personal capacity and situational factors when making cost-effort decisions (Cardenas et al., 2013). Several factors impact on personal perceptions of capacity. These include self-defeatist beliefs, personal values and goals, and self-esteem (Thonon et al., 2020). These components are described as having a top-down influence (i.e. impacting on more discrete cognitive processes) on approach motivation in relation to a specific chosen goal, although they likely interact with each other and bottom-up approaches are also possible. Similarly, Medalia and Brekke (2010) argue that in addition to estimations of value, perception of success, and personal weighing of extrinsic and intrinsic motivators (e.g. monetary gain or mastery over a task respectively) are important determinants of approach motivation.

Analysis of these cognitive mechanisms could give a more multifaceted understanding of how negative symptoms develop and are maintained, however these components are less commonly measured. Some studies show that both the self-rated importance of a task and perceived competency are predictive of effort expenditure (Choi et al., 2010), suggesting these cognitive factors do impact on neurocognitive mechanisms linked to negative symptoms. This section will therefore discuss in greater depth some of these cognitive components. Discussion is influenced by the model mentioned by Thonon et al. (2020), however the discussion of defeatist beliefs, reflected in the section on negative expectancy appraisals, is much broader. In contrast little discussion is focused on self-esteem. There is supporting evidence that negative symptoms and self-esteem are related (Jones et al., 2010; Lysaker et al., 2009; Palmier-Claus et al., 2011) and low self-esteem may confer low expectations of competency.

1.3.2.1 Self-esteem

Self-esteem may moderate the relationship between social cognition and negative symptoms (Lincoln et al., 2011). However, as self-esteem is less often incorporated in the research discussed in this section, it will not be discussed further here.

1.3.2.2 Negative expectancy appraisals

Thonon et al. (2020) summarise many of the cognitive biases likely to be specific to the development and maintenance of negative symptoms as discouraging beliefs. They draw specifically from the Rector et al. (2005) discussion of cognitive biases, where defeatist performance beliefs (a specific subset of discouraging beliefs) are highlighted. Several cognitive biases (in addition to value representation and outcome expectancy biases which have already been discussed in previous sections) could be conceivably described as discouraging beliefs, including perception of limited resources (or low self-efficacy), defeatist performance beliefs and low expectancies for acceptance.

Defeatist beliefs can be considered a broad range of negative expectancies related to different domains including performance, social acceptance, and likelihood of pleasure (Rector et al., 2011). Defeatist performance beliefs are possibly most researched within negative symptoms and can be generally

regarded as manifestations of core beliefs that a person is a “failure” or “worthless” if they cannot complete a given task to a high standard (Rector et al., 2005). This cognitive bias about engaging in performance (i.e. that it is risky or not worth the effort), seeks to maintain avoidance of threat associated with engaging in activities where the individual might not have the psychological resources to cope or may be viewed negatively by others. The Defeatist Performance Beliefs subscale of the Dysfunctional Attitudes Scale (Rector, 2004) is often used to measure these views. It incorporates beliefs about performance in general (i.e. “if you cannot do something well, there is little point in doing it at all”), and also beliefs about the negative impacts of poor performance (“taking a small risk is foolish because the loss is likely to be a disaster”). Arguably, this also incorporates beliefs around acceptance in relation to performance (“people will probably think less of me if I make a mistake”). As these appear conceptually distinct it might be important for further research to assess any item level discrepancies in endorsement of these beliefs in people with negative symptoms.

Separate to this is the actual perception of self-competence, as opposed to the perceived consequences of poor performance, that each person holds (for example, I can believe making mistakes is foolish and has negative consequences, while also holding the belief that I rarely make errors). Both defeatist beliefs (Grant & Beck, 2009) and perceptions of low competence (Choi et al., 2012b) are associated with psychosis symptoms. However, self-perceived cognitive impairment often does not accurately reflect cognitive capacities (Balzan et al., 2014; Saperstein et al., 2012). Furthermore, beliefs about cognitive ability mediate the link between cognitive impairment and functioning (Grant & Beck, 2009) and cognitive impairment and subjective perceived value of a given task (Saperstein et al., 2020), respectively. This indicates that while perceived cognitive deficits may be an accurate reflection of individual difficulties, when these perceptions are an overestimate, they might detrimentally affect functioning and task engagement (Treichler et al., 2019). This is important as studies have found that the perception of competence is essential for the translation of cognitive abilities, such as making financial decisions, to enacting these skills in daily life (Cardenas et al., 2013).

Choi et al. (2010) finds that when a task is mundane or has little immediate value the role of self-competence is more important, and protective from disengagement. Furthermore, the role of competency assessment may be more specific to experiential rather than expressive deficits (Chang et al., 2017b; Ventura et al., 2014), as is defeatist performance beliefs (Campellone et al., 2016b). Therefore, there is strong support for the notion that if individuals perceive themselves as incompetent they are less likely to initiate motivated behaviour, even when controlling for other mechanisms leading to motivational deficits such as neurocognitive difficulties. However, studies also find no indication of a relationship between negative symptoms measured with the BPRS and perceived self-competence (Choi et al., 2010; Choi & Medalia, 2010; Choi et al., 2012a). Further research is required to therefore assess the methodology of these studies and determine whether associations between low self-confidence and negative symptoms are reliable.

1.3.2.3 Values and goals

An assumption in the discussion so far is that people with negative symptoms value social affiliation, financial acquisition or security, and competence (or mastery of a specific task). The critical analysis of this assumption in the literature is relatively limited; however it is important to discuss some of the factors that may be considered when exploring personal values and goals. Medalia and Brekke (2010) discuss Frith's model of stimulus-response and self-initiated actions as representing extrinsic and intrinsic motivators respectively. For example, an individual may be motivated to complete a task measuring neurocognitive functioning because they will be rewarded with money (an extrinsic motivator; dependant on the situation at hand) or because they want to develop mastery of the task (an intrinsic motivator; dependant on subjective value of mastery). It has been noted that both intrinsic and extrinsic motivators are multifaceted and need further reification to explore their relationship (Luther et al., 2019). Kremen et al. (2016) conclude that there is evidence that people with negative symptoms attribute lower value to both intrinsic and extrinsic motivators, however most research is lab-based studies or uses relatively narrow self-report measures.

Some intrinsic motivators stand out as consistently measured and related to negative symptoms. Autonomy and personal relevance predict motivation for a task (Choi & Medalia, 2010) and are inversely related to negative emotion in persons with negative symptoms (McCormick et al., 2012). Curiosity is also a strong indicator of intrinsic motivation which has implications for the relationship between negative symptoms and employment outcomes (Saperstein et al., 2011) and this may even be more important than extrinsic motivators such as positive financial implications (Reddy et al., 2016a). The importance of extrinsic motivation (such as punishment avoidance, monetary gain or social appraisal) does not appear as strongly related to negative symptoms (Luther et al., 2019). Deficits in recognising external motivators are therefore possibly not as prevalent in persons with negative symptoms compared to difficulties identifying intrinsic motivators.

As described in the summary of neurocognitive mechanisms involved in development and maintenance of negative symptoms, daily life social rewards are particularly difficult to operationalise compared to rewards used in laboratory studies. Yet experience sampling methodology indicates that individuals with psychosis show desire for social interaction (Gard et al., 2014a; Tremeau et al., 2013) which may even serve as a protective factor in recovery from psychosis (Fulford et al., 2018b; see Fulford et al., 2018a for a full discussion). However, the overall picture suggests individuals with negative symptoms act conservatively in response to naturally occurring social rewards; Gard et al. (2014b) finds that people with psychosis are less likely to engage in goals focused on autonomy, competency or extrinsic rewards (compared to avoidance of punishment). Discrepancies in findings could be caused by the variety of interactions individuals are likely to experience and the differing ways they can be internalised.

For example, life experiences impact on the availability of enriched, varied and fulfilling environmental opportunities for people experiencing psychosis (Lincoln et al., 2017). The role of trauma in the development of negative symptoms is poorly understood with mixed findings (Chae et al., 2015; Turner et al., 2020b) and relatively small in effect size when compared across studies (Alameda et al., 2021). Only certain forms of childhood trauma, such as neglect are related to negative symptoms in some studies (Gallagher & Jones, 2013; Kilian et al.,

2018). Factors influencing these findings could include that the original PANSS factor structure is often used which is less representative of experiential deficits; and the relationship between trauma and negative symptoms might be more complex and mediated by other factors including other symptoms and cognitive abilities (Isvoranu et al., 2017; Weijers et al., 2018; Mansueto et al., 2019).

Additionally, individuals with more severe negative symptoms or trauma histories may be underrepresented in research (Mansueto et al., 2019), and subgroup analyses in some studies suggest experiences of trauma may be more prevalent for those with more severe negative symptoms (Rajkumar, 2015). Individuals with psychosis may also experience adverse events throughout the lifespan, including the experience of psychiatric hospitalisation, which may then contribute to the persistence of links between trauma and symptoms (Morrison et al., 2003; Oshima et al., 2005). Overall, current evidence suggests that the role of trauma in the development of negative symptoms makes conceptual sense, and in persons with more severe negative symptoms especially, should not be ruled out as a potential cause or exacerbating factor (Lysaker et al., 2011g).

Social isolation, where individuals have few opportunities for social contact, is common in individuals who experience psychosis, and may even predict or predate the onset of psychosis (Gayer-Anderson & Morgan, 2013). Furthermore, individuals' social networks appear to decrease with the chronicity of illness experiences, particularly in relation to the number of mental health crises and hospitalisations. Further social factors, including low socioeconomic status, and experiences of public discrimination (Boydell et al., 2013), are also related to experiences of psychosis and socioeconomic factors can perpetuate social isolation by limiting the financial resources providing individuals with opportunity to engage in social life (Frost & Strauss, 2016b). Living in supported accommodation or living alone, with limited opportunity for social interaction or employment amplifies these negative effects (Gupta et al., 2012). More generally, less time in structured activity has been shown to predict negative symptoms (Kasanova et al., 2018).

There is empirical evidence to suggest that the quality of existing social relationships is often strained in persons with negative symptoms also (Gayer-Anderson & Morgan, 2013). Individuals with negative symptoms are likely to experience criticism, stigma and reduced satisfaction with their frequency of support from their social networks (Palumbo et al., 2015; Llerena et al., 2012a). Relapse risk may be increased and time to relapse is shorter in people with psychosis who experience more criticism (Koutra et al., 2015). Furthermore, where relationships, or individuals' attitudes to relationships, have been characterised by greater insecurity demonstrated through attachment preoccupation or avoidance, individuals are also particularly more likely to experience persistent negative symptoms, even when controlling for baseline negative symptoms and duration of untreated psychosis (Gumley et al., 2014c).

Social exclusion is an important predictor of cognitive difficulties and negative affect, indicating a generalised need for social affiliation (Lincoln et al., 2021). Individuals with psychosis may therefore respond to social threat in several ways. The literature on willingness to give trust in social situations in persons with negative symptoms is mixed (Campellone et al., 2016a; Campellone & Kring, 2018; Fett et al., 2016). These studies suggest that variance in trust may be related to sensitivity to unfair practises, which was mixed in these studies, and use of social withdrawal as opposed to affiliation strategies as a response to mis-trust being high in persons with negative symptoms (e.g. in Fett et al., 2016). Alternatively, individuals with psychosis may develop schemas which explain social exclusion, limiting feelings of psychological threat when exclusion occurs in the moment (Reddy et al., 2019). Researchers argue that further investigation of how individuals process or recover from these experiences is required to understand how these experiences are linked to increased negative symptoms (Lincoln et al., 2021).

Cumulatively, these social adversities are argued to contribute to feelings of "social defeat", where an individual perceives themselves as of lower social worth, influencing the development and maintenance of mental health difficulties. A competing theory named social drift, where individuals lose social connections over time as a result of mental ill health is also supported by some evidence (Riehle & Lincoln, 2018). There is possible sampling and item selection biases, and differences in the types of measures being assessed (Abel & Minor,

2021) which may contribute to the discrepancies across studies exploring these competing theories. However, despite some studies showing that negative symptoms can negatively influence social interactions (Abel et al., 2021; Lavelle et al., 2013; Riehle et al., 2015; Riehle et al., 2018), Jaya and Lincoln (2016) find that the social defeat model has more overall support than the competing social drift theory.

However, with negative symptoms specifically, it is arguably the impact social defeat has on negative perceptions of the self that lead to the continued development and maintenance of amotivation and other negative symptoms (van Nierop et al., 2014; White et al., 2013). Studies show that internalised responses to social adversity (such as developing negative schemas, including for example "I am inadequate") mediate the direct relationship between social adversity and negative symptoms (Jaya et al., 2017). Similar findings have been shown in relation to childhood adversity specifically (Kilian et al., 2018). This is conceptually consistent with the findings that many individuals with negative symptoms hold negative appraisals about the value of expending effort in social situations (Depp et al., 2016), and have low self-esteem due to self-perceived social cognition deficits, influencing the desire to withdraw (Rector et al., 2005) rather than difficulties identifying intrinsic and extrinsic motivators. Lincoln et al. (2011) reported that individuals with negative symptoms were likely to have low self-esteem, perceptions of low self-competence, and fewer beliefs that they are respected, trusted, loved and accepted by others. They argue that conceptually this pattern of beliefs helps explain how individuals with negative symptoms might perceive social situations as likely to result in failure, leading to withdrawal and amotivation.

Findings by Pillny et al. (2020) are also consistent with this, where individuals with negative symptoms experience more demotivating beliefs (including general perceptions around the likely payoff for expending effort; and their social abilities) which significantly predicted anticipatory pleasure and engagement in goal directed activity. Furthermore, there was stronger evidence for the impact of these beliefs on social domains, but not recreational and self-care activities, when all variables were included in the same model. This may also explain why negative symptoms and social anxiety are highly correlated in people experiencing psychosis (Lysaker et al., 2010c; Vrbova et al., 2018). In non-

psychosis specific research, anhedonia has been hypothesised to have distinguished subtypes, such as anhedonia related to a difficulty making sense of hedonic experience, and anhedonia as a form of shut down from painful affect (DePierro et al., 2014). It is possible that several cognitive pathways resulting in anhedonia need to be considered in relation to the development of negative symptoms in psychosis also.

1.3.2.4 Summary

Overall, the studies reviewed here demonstrate that a solely neurocognitive explanation of the development and maintenance of negative symptoms is likely to be incomplete, and cognitive biases are likely to have a significant impact on the development and maintenance of negative symptoms. In particular, negative views of the self in relation to experiences of social adversity do impact on people's expectations and valuing of future social situations in persons with negative symptoms. In exploring higher-order cognitive processes, it is also apparent that many of the factors that predict negative symptoms (e.g. social isolation) are also likely to become reinforced and ultimately consequences of the symptoms identified (i.e. a vicious cycle). This offers several potential points of intervention which might ultimately lead to changes in negative symptoms. However, further research is required to identify which of these cognitive mechanisms described might have the biggest influence in predicting the course of negative symptoms, and how these mechanisms might also be impacted by neurocognitive deficits.

Furthermore, cognitive biases still do not completely explain the development and maintenance of negative symptoms, with findings in several areas being heterogeneous (for example the discrepancies in perceived self-competence, the importance of extrinsic motivators, and responses to adverse experiences). Additionally, the explanatory power of some cognitive biases such as defeatist performance beliefs is limited, and it's likely that the impact of mechanisms like this have different impacts depending on the severity of negative symptoms (Campellone et al., 2016b). Furthermore, the impact of personal awareness of self and cognitive biases is likely to have an impact on these findings. For example, Kurtz et al. (2013) found that in persons with negative symptoms, only those with cognitive insight exhibited a link between perceptions of low self-

competence and poor functioning. This indicates that awareness of one's own cognitive processes might also be an important component through which these factors interact.

1.3.3 Metacognitive models

Both neurocognitive and cognitive models indicate that the way an individual makes sense of experiences can impact on the development and maintenance of negative symptoms. Metacognition is broadly the capacity for thinking about thinking (Flavell, 1979), however several subtypes of metacognition have been distinguished (Moritz & Lysaker, 2018). Perhaps most widely investigated include metacognitive knowledge, which are the beliefs one holds about oneself, others, social life, and even cognitive processes themselves. Evidence previously discussed around cognitive biases (e.g. I am a failure or incompetent) are an example of metacognitive "knowledge" a person may hold in that these beliefs reflect a representation of the self. An increasingly nuanced ability to hold oneself in mind is required to develop insight about one's experiences of illness, for example this would go beyond simply recognising a desire to be socially withdrawn from others, but being able to recognise this desire as a symptom of an illness or willingness to avoid pain (Lysaker et al., 2011e).

Metacognitive experiences are another subclass of cognition which has been explored. This involves in the moment reflections about cognitive processes, such as feelings of anticipation or trepidation, confidence, enlightenment and surprise (Moritz & Lysaker, 2018). Generally, research so far has targeted awareness of biases in thinking which when explored allow individuals to have metacognitive experiences which challenge these views, generating new metacognitive knowledge (Moritz et al., 2016). Often this is explored in relation to the confidence an individual attributes to their beliefs.

Research suggests that individuals with psychosis are more likely to display confidence in their judgements (regardless of how accurate those judgements are), and this is associated with reduced metacognitive awareness that one's judgements can be fallible (Köther et al., 2012). The relationship between overconfidence in judgements in persons with negative symptoms is relatively less explored than the relationship between overconfidence and positive

symptoms with few studies reporting any direct findings, and only two studies have shown a direct relationship between negative symptoms and self-certainty (Van Camp et al., 2017). This could suggest that individuals with negative symptoms are more rigid in their thinking styles when making decisions.

The other composite element of cognitive insight, self-reflectiveness, is also only examined in a few studies in relation to negative symptoms and is generally found to be inversely related to negative symptoms (i.e. higher negative symptoms are associated with lower self-reflectiveness; Riggs et al., 2012; Van Camp et al., 2017; Köther et al., 2012; Köther et al., 2017), although several studies also found non-significant (Lysaker et al., 2011i; Riggs et al., 2012; Van Camp et al., 2017) and indirect (Garcia-Mieres et al., 2020) relationships. Moritz and Lysaker (2018) suggest that insight is a multifaceted construct. Given that much research to date has relied on a bottom-up approach and there is little theory informing models of negative symptom development and maintenance, more precise exploration of how components of metacognition interact with negative symptoms is therefore warranted.

These metacognitive knowledge and experiential components are often exercised in tandem with the other two metacognitive capacities mentioned by Flavell: generating metacognitive goals and metacognitive strategies. Generally the distinction between these two factors is poorly defined (Moritz & Lysaker, 2018). Metacognitive goals could be a desire to remain aware of or in control of one's thoughts (as assessed by the need to control thoughts scale of the Metacognitions Questionnaire (Wells & Cartwright-Hatton, 2004)), the desire to act in accordance with one's preferences (Lysaker & Dimaggio, 2014), or the aim to gain mastery over generalizable skills (Cella et al., 2015b). Individuals may respond to metacognitive goals in a variety of ways, which could include metacognitive strategies, for example in the case of the goals listed, individuals might react by ruminating on or evaluating the effectiveness of specific cognitions; might simulate scenarios in which anticipated affect can be evaluated in relation to one's preferences; and may plan, monitor and evaluate their performance on cognitive tasks. In this way, metacognitive capacities are likely to be relatively independent (i.e. an individual may be able to form metacognitive goals, but lack the capacity to evaluate their thinking effectively), even though they are linked.

In many ways there is descriptive overlap between the content of metacognitive processes and many of the neurocognitive and cognitive capacities already described (i.e. decision making). Exploring thoughts and behaviour through a metacognitive lens offers a potentially more integrated understanding of processing deficits and explains how they might result in apparently inconsistent deficits (i.e. ability to make sense of options, but difficulty utilising this knowledge to make optimal choices; Cella et al., 2015a; Moritz & Lysaker, 2018). Studies already discussed indicate individuals with negative symptoms have difficulty valuing and making sense of affective responses to social stimuli, and trusting ones' judgements, which can be considered a difficulty with metacognition. Similarly, insight can be regarded as a form of knowledge relative to the self and whether behaviours might be regarded by others as symptoms of mental distress (Lysaker et al., 2011e). Individuals with negative symptoms are often shown to have poorer insight (Erickson et al., 2011; Kurtz et al., 2013; Wong, 2020), which can impact on wellbeing (Montemagni et al., 2014) and relationship building in psychological therapy (Lysaker et al., 2011d).

Overall this highlights that individuals must have some idea of their own self (including preferences, dislikes and understanding of general behaviours) as well as others to be able to make sense of the actions oneself and others might be likely to take (Lysaker et al., 2011g). If individuals with negative symptoms experience difficulties in this area it is understandable that they might have problems with motivation. One study indicates that motivation can only be present when prerequisite levels of metacognition are already present (Luther et al., 2017). Metacognitive difficulties seem to be proportionately related to experiential negative symptoms, specifically around experiences of pleasure (Buck et al., 2014), and to negative symptoms generally (Hamm et al., 2012).

Similarly, the capacity for self-reflectivity has been implicated as a partial mediator in the relationship between cognitive deficits and diminished expression (García-Mieres et al., 2020). Additionally, compared to other predictors, McLeod et al. (2014) found that metacognition explained 62% of the variance in negative symptoms at both 6 and 12 months after a first experience of psychosis when controlling for duration of untreated psychosis and premorbid adjustment. This suggests that metacognition is an important variable in considering the development and maintenance of negative symptoms. However,

there is a relatively smaller evidence base exploring these constructs versus neurocognitive and social cognition difficulties. Further research is therefore needed to expand this evidence base and gain further understanding of how different components of metacognition might be related to negative symptoms in different ways.

1.4 Chapter summary

Overall, negative symptoms are a multifaceted cluster of difficulties that are not unique to, but highly impactful for persons experiencing psychosis, particularly when these experiences continue over time. While negative symptoms affect recovery as much as other psychosis symptoms, the development and testing of treatment models is less advanced than the approaches designed to address positive symptoms. There are likely several pathways which explain the development and maintenance of negative symptoms, which perhaps explains why individuals vary in the mix of negative symptoms they show. It appears that most emerging research is developed within a neurocognitive model of negative symptoms, where many neurocognitive capacities are implicated in symptom development. However, research exploring cognitive biases demonstrate that these also account for significant variance in negative symptom development and maintenance. This suggests that targeting neurocognitive factors alone will lead to meaningful improvement in negative symptoms.

However, neither neurocognitive or cognitive variables sufficiently explain variance in negative symptoms completely, and there are areas of debate and inconsistent evidence studies exploring these factors. Exploration of metacognition offers a potentially unifying lens through which negative symptom variance can be explained as a function of difficulty making sense of self-referential processes and the minds of others. However, the evidence base exploring metacognition and negative symptoms is relatively limited. Given these issues outlined the overarching aim of this thesis is to explore the relationship between negative symptoms and metacognition. This will help identify ways in which metacognition might help improve psychosocial recovery from negative symptoms. The next chapter will explore how these issues discussed have been translated to different treatments for negative symptoms, exploring potential target mechanisms and any evidence for a mechanistic

approach between intervention constructs and negative symptom outcomes. Similar to this chapter, the possibility of metacognition as a theoretically coherent integrative mechanism which could impact treatment is discussed.

Chapter two: Current treatments for negative symptoms:

2.1 Chapter overview

One of the most important implications of identifying mechanisms involved the development and maintenance of negative symptoms is that this can lead to more effective treatments. The literature reviewed in Chapter 1 indicates that negative symptoms are relatively less explored compared to other symptoms in psychosis. Inadequate models of mechanisms that lead to negative symptom development and maintenance mean treatments are less specific to negative symptoms which may explain why the effectiveness of some treatments for positive symptoms do not generalise to negative symptoms of psychosis (Fusar-Poli et al., 2015). Furthermore, studies demonstrate that other treatments for negative symptoms, including antipsychotics, are less effective paralleled with their treatment effects for positive symptoms (Fusar-Poli et al., 2015; Krause et al., 2018). One of the factors influencing this limited treatment efficacy is that due to a lack of theoretical understanding, it is unclear whether existing treatments better target primary or secondary negative symptoms, and study samples are often confounded. This is an issue which is also replicated in data exploring psychosocial interventions.

There are calls to ensure that treatments for psychosis aim to target specific mechanisms, as it is likely that manipulating mechanisms which have a specific theoretical impact on particular symptoms will be effective for treatment in comparison to adapting generic treatment approaches to specific presentations (Brown et al., 2019). While research pursuing this approach have been relatively successful in the case of positive symptoms, further research is needed to explore the relative success of current treatment approaches for negative symptoms.

Of existing treatments, only Cognitive Behavioural Therapy and Arts Therapy are currently recommended by the National Institute for Health and Care Excellence (NICE) for the treatment of negative symptoms specifically (NICE, 2014). However, these treatment approaches are not developed with specific consideration of mechanisms involved in negative symptom development and

maintenance. Criterion for acceptance in NICE guidance is also dependant on an extensive evidence base, and risk of bias issues in individual studies may not be fully incorporated, suggesting the review of other treatments may also be warranted (Turner et al., 2014). Existing reviews indicate that there is some success with other therapies treating negative symptoms, however largely they are not as successful as they are in their treatment of positive symptoms and the evidence base is limited to a few studies (see Elis et al., 2013 for a review).

Against this backdrop, this chapter will summarise the different treatments which have been utilised for negative symptoms and critically examine treatment effects relative to the extent to which treatment approaches are informed by proposed psychological mechanisms related to negative symptom mechanisms. This approach allows generic treatment effects to be differentiated from negative symptom-specific treatment effects. This chapter will conclude with rationale which supports the possibility that metacognitive treatments offer an integrative and theoretically driven approach to understand and ameliorate negative symptoms.

2.1.1 Cognitive Behavioural Therapy

Cognitive Behavioural Therapy focuses on the link between thoughts, behaviour, emotions and physical reactions. In CBT for psychosis, therapist and client collaboratively establish how interpretations and expectations around events can evoke negative beliefs and feelings such as distress which result in behaviours attempting to cope with these (Morrison & Barratt, 2010). Through generating this awareness, individuals can then practise challenging specific thoughts and executing behavioural strategies to alter cycles which may inadvertently reinforce symptoms. CBT for psychosis has been studied more extensively than any other psychological therapy and shows a relatively strong and persistent evidence base, whereby individual CBT appears helpful in reducing negative symptoms (Elis et al., 2013) with meta analyses demonstrating a moderate effect size of 0.437 (Wykes et al., 2008) and more recent work indicating a 0.34 reduction in negative symptoms following CBT across studies (Lutgens et al., 2017b).

2.1.2 Arts-based psychotherapies

Arts therapies focus more broadly on the development of self-expression through creative modalities where verbal communication is not necessarily required, such as dance, movement, drama, art and music, in a safe supportive space. They have a strong recovery focus and evidence suggests they might be effective, across modalities, in reducing negative symptoms, with moderate to large effect sizes (NICE, 2014). However, in the NICE guidelines, arts therapies are combined, but in actuality they represent several different interventions which may or may not have specific effects. Furthermore, since their publication, the recommendations in these guidelines have been questioned given that effects are not replicated in new studies (Leurent et al., 2014; Attard & Larkin, 2016). Neither the complex psychosis NICE guidelines or the Scottish Intercollegiate Guidelines Network (SIGN) recommend the routine use of art therapy (NICE, 2020; Scottish Intercollegiate Guidelines Network (SIGN), 2013).

One limitation of arts therapies outcome studies is that the active mechanism is unclear. Research indicates that exercise in general may be effective for treatment of negative symptoms, but exercise emphasising a mindful connection with the body and movement is perhaps a more important predictor of greater effectiveness. Vogel et al. (2019) found a Hedge's G of 0.461 for mind-body exercise versus 0.434 and 0.341 for physical and aerobic exercise respectively, while Sabe et al. (2020) found a small but significant standardised mean difference of -0.24 in negative symptoms for persons engaging in physical exercise alone versus treatment as usual. This latter study also suggested that non-aerobic exercise (such as yoga) did not have a significant effect on negative symptoms in sensitivity analysis, however this systematic review excluded many studies for including a mind-body component perhaps limiting several significant findings which could have contributed to this analysis. While mind-body therapies appear to be effective, it is also unclear to what extent meditation is incorporated in each of these (e.g. in yoga, Sabe et al., 2019) and there is high heterogeneity in existing meta-analyses (Sabe et al., 2019; Wei et al., 2020).

Furthermore, more rigorous trials of body-oriented psychotherapies do not always show a clinically significant impact of this type of therapy (Priebe et al., 2016; Priebe et al., 2013). One study suggests that although improvements in

sense of self and negative symptoms have been shown to improve concurrently in some pilot studies (Rohricht et al., 2009), these effects appear non-specific and negative symptom improvement is not linked to the hypothesised treatment mechanism. These methodological considerations are important, and rigorous studies separating these components are required.

Dance Movement Therapy (DMT) is one art-based psychotherapy which has a relatively large existing evidence base. It focuses on embodied movement as an alternative mechanism for stimulating the capacity for emotion and self-reflection in persons with negative symptoms (Bryl & Goodill, 2020), while engaging in purposeful activity. Evidence indicates that several participants involved in dance therapy report benefits in line with goals of expressing and experiencing emotion as well as generating alternative mechanisms for communication (Bryl & Goodill, 2020; Bryl et al., 2020) even when in the latter study this did not match improvement in clinical measures of symptoms. In addition to reported facilitation of social integration and experience of emotions, some studies do demonstrate a clinically noticeable impact on negative symptoms, with DMT associated with improvements in negative symptoms in comparison to a control group receiving standard care (Gökcen et al., 2020), and accounting for a 20% reduction in negative symptoms in another study (Martin et al., 2016). To be more certain of the impact of DMT on persons with negative symptoms higher quality trials need to be conducted and replication of effect sizes of treatment in comparison to treatment as usual or other active controls needs to be established.

Music therapy shows a similarly positive impact on negative symptoms with studies showing a standardised mean difference of -0.55 to -.56 for people with negative symptoms receiving music therapy in addition to treatment as usual (Geretsegger et al., 2017; Jia et al., 2020). The risk of bias assessment and review of confounding factors across studies (such as differences in treatment as usual) is similar to that of movement-based therapies. Music therapy, like other arts-based therapies, has a psychosocial impact on persons with negative symptoms, however it is unclear whether this would be sufficient alone to improve experiences of negative symptoms. Geretsegger et al. (2017) highlight uncertainty as to whether the effects of music therapy are based upon improvements in social functioning, or the opportunity to engage in motivating

or affect-laden activity (and whether this would be successful without other therapies also incorporated). The evidence base for fine-art therapies is also uncertain as methodological rigour across studies is generally low (Laws & Conway, 2019). Some studies demonstrate clinical impact (Richardson et al., 2007; Montag et al., 2014), and some do not (Crawford et al., 2012). Additionally, due to the low evidence base and limited contexts in which art therapy occurs, there is little consensus amongst arts therapists as to the mechanisms by which art therapy provides benefit (Holttum et al., 2017). Variability in practise therefore leads to difficulty in systematically identifying unique explanatory mechanisms linked to art therapy, and could hamper more standardised practise (e.g. through manualisation).

Overall it is likely that all arts therapies provide some benefit to persons using them, although the specificity of these effects is unclear, with several common mechanisms (such as providing a vehicle for connection with the self and self-expression) being a possible cause of benefits (Carr et al., 2021). Additionally, the degree to which the intervention staff subscribe to specific psychological approaches (for example taking a psychodynamic approach versus a general focus on expression through art, Wood, 2013), or whether they employ additional therapeutic techniques (such as motivational interviewing, Cho & Lee, 2018) might lead to variance in treatment effectiveness. Participant level factors may also affect the intervention, although which of these has significant impact is still uncertain. For example, in one trial of art therapy, neither severity of negative symptoms or desire to engage in fine arts impacted on clinical effectiveness (Leurent et al., 2014). Additionally, the availability of these interventions across services supporting persons with psychosis may be limited (for example art therapy, Patterson et al., 2011).

2.1.3 Cognitive remediation

Cognitive Remediation (CR) is generally recognised as neurocognitive training (often computerised) which helps to develop working memory, attention, and other cognitive processes in order to improve function which may be required to engage in the more complex aspects of other therapies (Wykes et al., 2011). Few studies have examined CR targeting negative symptoms specifically, but network meta-analyses suggest there is a small to moderate effect of cognitive

remediation therapies for negative symptoms (Cella et al., 2017a). In individual studies the evidence base is relatively weak, possibly due to studies being underpowered, and it is unclear which elements of cognitive remediation training are most important. For example where working memory has been the focus, improvements are not specifically related to improvements in negative symptoms (Cella et al., 2017b), unless in domains which are perhaps more appropriately associated with cognitive disorganisation (i.e. inattentiveness, Li et al., 2019). The ability to develop social participation and executive functioning during therapy (Kosugi et al., 2019; Cella et al., 2017a), and the type of memory targeted (i.e. more self-referential autobiographical memories, Edwards et al., 2020) may also influence results.

Impact on specific negative symptoms is also inconsistent across studies. For example one study finds improvements through cognitive remediation therapies in experiential but not expressive deficits, even though only the latter were related to specific areas of cognition at baseline (Sevy et al., 2020). In comparison, another study found reductions in both experiential and expressive deficits in a group receiving a form of CR versus controls (Mahmood et al., 2019). It could be that other factors such as severity of negative symptoms impact on the deficits experienced leading to differential effects of treatment (Cella et al., 2014) although it is unclear how this might impact differently on subtypes of negative symptoms. Overall, evidence for effectiveness of CR is promising, although not conclusive, and it is unclear whether the effects are in excess of those seen with other treatment modalities. NICE guidelines for complex psychosis evidence did not find enough data across studies to suggest a benefit of cognitive remediation alone in improving interpersonal functioning, however studies did suggest that cognitive remediation in addition to vocational rehabilitation had improved effects compared to vocational rehabilitation alone. For this reason NICE guidelines recommend the inclusion of cognitive remediation in vocational rehabilitation for complex psychosis (NICE, 2020).

2.1.4 Social skills training

Social Skills Training (SST) is a broad term encompassing psychological interventions which aim to improve psychosocial functioning (Kurtz & Mueser, 2008). While these interventions typically incorporate behavioural techniques

such as modelling and rehearsal with feedback, more complex therapeutic techniques are also incorporated here such as cognitive restructuring and modelling to adapt existing beliefs about social relationships. The combination of these techniques aims to increase reflection on social situations, and allow perceptions of context-specific indicators which might influence response, and to increase assertiveness and communication (Turner et al., 2018). Alongside CBT, Elis et al. (2013) found support for SST in the treatment of negative symptoms had the most empirical support. The meta-analysis by Turner et al. (2018) found a 0.3 effect size (Hedge's g) of SST in comparison to treatment as usual for negative symptoms. This suggests a promising treatment target which appears more effective than pooled CBT studies for treating negative symptoms in other studies (Turner et al., 2014). However the majority of CBT studies in this meta-analyses did not directly target negative symptoms, meaning while SST might be more effective than generic CBT, the impact of SST versus CBT targeting negative symptoms must still be established.

In contrast, Cognitive-Behavioural SST (Granholm et al., 2016), combines SST with specific problem solving modules and a focus on defeatist performance and asocial beliefs. The effectiveness for these studies in a recent meta-analysis was 0.15 which is relatively smaller compared to other treatments which are less specific to negative symptoms. However, it is likely these analyses were underpowered. There is evidence to suggest that treatment effects for CBSST are mediated by reduction in dysfunctional attitudes. This may suggest that targeting perceptions of self in social scenarios is a necessary function of social skill improvements leading to an improvement in negative symptoms (Granholm et al., 2018), alongside the goal setting component of SST increasing behavioural activation (Granholm & Harvey, 2018). A more recent study (Granholm et al., 2021a) including an additional treatment focus on compensatory cognitive training (containing modules with similar focus and aims to cognitive remediation) found a significant treatment effect for people with moderate to severe negative symptoms (0.22 of the variance in negative symptoms explained by group by time interaction, p=0.49). However, this evidence base is still limited and further research is required to establish if this effectiveness is sustained in other samples (Turner et al., 2018).

2.1.5 CBT-n

Researchers have more recently found that when CBT is non-specific to negative symptoms, the effect size for symptom improvement is small and as more studies have been conducted the evidence base for the effectiveness of CBT for negative symptoms appears weaker overall (Velthorst et al., 2015; Turner et al., 2020a). The heterogeneity of CBT approaches and difference in duration of treatment across studies may have contributed to these findings. Evidence from individual studies has suggested that CBT can be effective for the treatment of negative symptoms especially when targeting self-defeatist beliefs specifically (Grant et al., 2012; Staring et al., 2013; Klingberg et al., 2011), with one follow-up study demonstrating a moderate treatment effect (Cohen's d = 0.66) 6 months post treatment (Grant et al., 2017). The mechanism by which CBT is thought to reduce self-defeatist beliefs is through creating guided experiences of success which can help activate beliefs endorsing a more positive and competent self-concept (Grant et al., 2018). With further study required for confirmation it also seems that CBT adapted in this way is also suitable for mobile delivery for persons with experiential, but not expressive deficits (Granholm et al., 2020).

CBT for negative symptoms may however incorporate slightly different techniques or structure across interventions (Staring et al., 2013; and in some studies, show similar effects to other treatments such as Cognitive Remediation Therapy; Klingberg et al., 2011). Existing studies also predominantly target patients with high levels of negative symptoms, low functioning and residual positive symptoms, which means the therapy may not be applicable for all individuals with negative symptoms. Additionally, as these have been modified from existing CBT, they do not incorporate current understanding of motivation and anhedonia. Researchers have suggested that researchers should incorporate different beliefs impacting on motivation including social indifference, low self-esteem (Pillny et al., 2018) and anticipatory pleasure deficits (Strauss, 2013b). However, the overarching principles of CBT, that challenging existing thoughts and engaging with behaviours as an experiment to determine whether they generate a desired effect is incorporated throughout the other therapies discussed here. Some therapies which explicitly build upon CBT, and the mechanisms they focus on are discussed below. Overall CBT therapies are relatively modular and Thonon et al. (2020) demonstrate through the Switch

intervention that different components can be combined effectively, for example the use of decision-making tools to enhance effort-cost computation abilities improve motivation, and mindfulness to limit demotivating beliefs. Further work is required to establish whether the effects demonstrated in any of these therapies are reliable for people with negative symptoms.

2.1.6 Common therapeutic factors

2.1.6.1 Scaffolding

Several therapies which are effective include scaffolding as one of the main components of the therapy. Social connection is a particular form of scaffolding likely to occur in therapy which may even serve as a confound in the effectiveness of existing interventions. Assertive Community Treatment (ACT), for example, is also relatively effective in treating negative symptoms, and one of the primary mechanisms includes generating extended social contact, with changes in social motivation acting as a key mechanism in improved functioning and quality of life in response to ACT (Schmidt et al., 2018). Furthermore, Fulford et al. (2018a) argue that the effectiveness of interventions such as social skills training are unlikely to extend post-intervention if individuals are not engaging in sufficient opportunities for these skills to be maintained, although few studies empirically test this.

CBT-based interventions also generally scaffold the opportunity for participants to identify and engage in interventions meaningful to them. Not all engagement in goal-directed behaviour is likely to be effective, one study showed that participating in a sky-dive did not show any additional efficacy above the impact of personalised feedback on lifestyle options based on participants' pleasure responses to their usual activities (Van Roekel et al., 2017). It is likely that generating engagement in activities meaningful to each individual is more important for effectiveness. However, the interventions incorporating prompts and structuring to maintain engagement in motivated behaviour appear effective (Velligan et al., 2015; Schlosser et al., 2016). Researchers have suggested that digital technology which can support self-management is therefore likely to be an important component of future interventions, and there is success in adapting existing interventions also (Granholm et al., 2020).

2.1.6.2 Present-moment awareness

"Third wave" therapies build on CBT principles to incorporate a greater focus on cultivating non-judgemental awareness of beliefs and neurocognitive difficulties, and generating compassion and acceptance for oneself with this in mind. Mindfulness-based therapies, which have an emphasis on meditative practise and focusing on the self in the present moment show some evidence of effectiveness in treating negative symptoms (although see Louise et al., 2018) which is relatively small in some studies (g = 0.24, Jansen et al., 2020) and heterogeneous in those with high effect sizes (g = 0.75 with an I^2 statistic of 73.34%, Khoury et al., 2013). However, few of these studies were designed with the explicit focus of targeting negative symptoms. Loving kindness meditation has a specific focus on emotional activation incorporated alongside mindfulness and gratitude exercises. The intervention has been received positively by participants with negative symptoms (Caponigro et al., 2014; Johnson et al., 2011), but as larger controlled trials have not been conducted the active components are unclear. Although only one component of meditation, studies have shown the using guided imagery and visualising success is likely to be an effective treatment mechanism in people with experiential deficits (Cox et al., 2016).

Focusing more on factors involved in the development and maintenance of anhedonia, the Positive Emotions Program for Schizophrenia (PEPS) focuses on modelling the need to pay prolonged attention to (and savour) positive experiences. It also incorporates social skills training to encourage participants to display emotions in addition to cognitive restructuring around defeatist beliefs and low self-compassion (Favrod et al., 2015). Interestingly, some evidence shows the intervention is feasible and effective for both experiential and expressive deficits, particularly in younger populations (Favrod et al., 2019b). The general effects on experiential deficits, as the main target of the intervention, appear sustained in controlled trials (d = -0.55 for SANS apathy and anhedonia composite score for people receiving PEPS), and sustained over 6 months (Favrod et al., 2019a). Further controlled research with an active control would assist in establishing the effectiveness of this intervention.

2.1.7 Metacognitive therapies

While individual components of each of these therapies described above could have some effect on negative symptoms, their evidence base is not particularly strong or theoretically driven. One of the critiques of modular approaches to therapy such as these described is that it is not entirely clear how these different components are integrated together to help individuals gain an appreciation of the self as a whole person. Moreover, if negative symptoms can be developed and maintained through a fundamental difficulty making coherent sense of oneself and others, then targeting specific cognitive biases may not be effective (Skodlar et al., 2013). Similarly, behaviour modification without generating a sense of agency in undertaking new actions may not help individuals generate intrinsic motivation (Hasson-Ohayon et al., 2017a). As an alternative, metacognitive therapies are focused on generating an awareness of oneself and the ways in which one may influence cognitive processes. Given that studies demonstrate level of insight (a closely related construct) is associated with better CBT outcomes for positive symptoms (Perivoliotis et al., 2010) it is possible increasing metacognition may be beneficial for people with negative symptoms as well.

Some forms of metacognitive therapy are more focused on self-integration than others. Metacognitive Therapy and Metacognitive Training both largely focus on how awareness of cognitive processes can help reduce cognitive biases (see Lysaker et al., 2018a for a review). Similarly, Metacognition-Oriented SST (MOSST) focuses on generating awareness of ones' own and others' mental states to improve social judgements (Inchausti et al., 2018). Overall these therapies are still relatively modular in that they can be broken down into the focus on specific beliefs or are applied to specific skills, but might not necessarily re-stimulate the capacity to understand oneself in a more holistic sense.

In contrast, both Metacognitive Reflection and Insight Therapy (MERIT) and Metacognitive Interpersonal Therapy for psychosis (MIT-p) are developed from a focus on metacognitive knowledge that an individual holds about themselves and how this is integrated into daily life (Lysaker et al., 2018a). MERIT most explicitly promotes activities within session that are not linked to specific beliefs or skills development but rather to collaboratively establish the patients'

agenda and how the didactic process of therapy influences participants achieving those aims. MIT-p (Salvatore et al., 2009) on the other hand is adapted from existing therapy aimed to treat persons diagnosed with personality disorder. Many of the components are similar to MERIT (developing a sense of the person's experiences, needs and wishes through didactic processes to establish how best an individual can pursue goals meaningful to them). In addition to this however MIT-p uses specific skill-building to support participants to critically evaluate their beliefs in a safe way and engage in behavioural activation to combat existing beliefs which impact pursuing specific goals. Mentalisation Based Treatment is another therapy which has been adapted for use with people experiencing psychosis (MBT-p) and aims to highlight specific ways in which understanding of oneself and others' mental states are influenced by previous attachment experiences, emotion regulation and the level of explicit refection when processing experiences (Brent et al., 2014). In this way each of these approaches are substantially more focused on creating an integrated and coherent account of oneself and how this influences social interactions. They share several similarities despite being derived from differing epistemological backgrounds (see Ridenour et al., 2019 for a full discussion).

Of these therapies, MIT-p has some evidence with case studies suggesting that MIT can be effectively adapted for psychosis and can help identify schemas contributing to negative self-beliefs in persons with schizophrenia diagnoses (Salvatore et al., 2009). However, only one case study demonstrates how MIT-p can help individuals make sense of their social experiences and why individuals might attempt to withdraw (e.g. protection from threat, Salvatore et al., 2012). Further research and theoretical work are required to establish how this can best be applied to negative symptoms and to assess the efficacy of the therapy in a controlled study with a larger sample. MBT-p has a similar evidence base with some studies showing that MBT and its derivatives (encompassing brief, group, and interaction focused options) show subjective benefit and modest improvements in social functioning (Lana et al., 2015; 2020; Riddell & Clouse, 2020; Weijers et al., 2020). However, these findings are not as pronounced for persons with longer-term experiences of psychosis (Weijers et al., 2020), and although some cases suggest how social withdrawal can be targeted through MBT (Debbané et al., 2016; Brent & Fonagy, 2014b) there has not been specific

assessment or tailoring to negative symptoms, and the Randomised Controlled Trial (RCT) focusing on MBT-p found no significant changes in negative symptoms for the group receiving MBT-p (Weijers et al., 2020). Finally, while tentative evidence suggests MBT improves metacognitive capacities, it is unclear how exactly mentalisation is improved and whether these effects are independent of the social scaffolding focused on in MBT.

MERIT is the only of these specific metacognitive therapies which has case evidence focusing on someone with severe negative symptoms (George & Buck, 2018) where negative symptoms appeared reduced as determined by a clinician. One potential mechanism through which this therapy may impact negative symptoms is by improving levels of insight (Vohs et al., 2018) or self-compassion (Hochheiser et al., 2020), which have both conceptually been related to negative symptoms. However, while MERIT may be feasible and impact on metacognition over time (de Jong et al., 2016; de Jong et al., 2019), these studies have not empirically demonstrated a clinical improvement in negative symptoms.

2.2 Chapter summary

There are several treatments and treatment components which are conceptually relevant to negative symptoms and several studies demonstrate a small to moderate effect on negative symptoms in persons with psychosis including social skills training, CBT and arts therapies. Treatment effects are generally weaker in meta-analyses, perhaps due to most studies not targeting negative symptoms specifically and because meta-analyses identify studies which might over-estimate the true treatment effect. New treatments are emerging which are more clearly guided by negative symptom specific theory, but the evidence base is small and these treatments are still in their infancy making it difficult to draw conclusions around their efficacy. More controlled studies are required and given that the population who experience negative symptoms are so heterogeneous and likely to experience different treatment outcomes (Stiekema et al., 2018a), closer targeting of groups with different symptom severity may be warranted. Overall, metacognitive therapies targeting the need to develop an integrated sense of self (MIT-p, MBT-p and MERIT) are most likely to address the criticism that modularity in therapy impacts on the ability of people with negative

symptoms to generate coherent reflections with MERIT having the most evidence direct to negative symptoms. However, further study is still required to fully understand the mechanisms involved and which therapeutic approaches might be superior to existing psychosocial treatments.

The next chapter will allocate an increased focus to the relationship between metacognition and negative symptoms, and present rationale for and the results of a systematic review exploring how these two constructs are characterised and related to each other in existing literature. This will further the understanding of whether metacognitive difficulties can be considered a meaningful mechanism in the development and maintenance of negative symptoms.

Chapter three: The relationship between negative symptoms and metacognition - A systematic review

3.1 Abstract

Background: Metacognition involves integrating information about the self and others to make sense of the world, and utilising this in formulating ways of coping with social challenges and psychological distress. Research has demonstrated that reduced metacognitive capacities are related to the development and maintenance of negative symptoms, but there is little systematic investigation of the relationship between these constructs and their subdomains.

Objective: To identify and characterise research exploring the relationship between negative symptoms and metacognition and synthesise findings across studies to summarise the evidence available, limitations and risks of bias.

Search Methods: PsycINFO, EMBASE, MEDLINE and Cochrane Library databases were searched for eligible studies measuring metacognition and negative symptoms in adults age 16+ with psychosis. Forward and backwards citation searching, hand searching of relevant journals and grey literature searching was also conducted. Authors of eligible studies were contacted to ensure identification of any additional eligible studies and to confirm relevant information, including overlapping data.

Selection Criteria: Studies were eligible if they included participants aged 16+ who experienced negative symptoms, and metacognition was measured. There were no exclusions based on population. Selection was restricted to quantitative research, excluding case studies, and English language publications.

Reliability: Studies were screened by two reviewers sequentially at title, abstract and full-text level to determine eligibility. Participant data and metadata of included studies was extracted by two reviewers using an excel spreadsheet combining original author and report information outlining the pre-specified variables of interest. Risk of Bias assessment was completed by two reviewers using the Quality in Prognostic Studies tool.

Results: Published reports were collated and overlapping reports and datasets were identified. 85 unique studies met inclusion criteria reflecting an estimated 32 datasets and 1,623 unique participants. Focus on and measures of negative symptoms and metacognition used across studies are summarised and comparisons between negative symptoms and metacognition are explored. These findings express a small to moderate relationship between metacognition and negative symptoms (correlation coefficients: 0.88 to -0.23), with some inconsistencies across studies. Risk of bias was considered low to moderate.

Discussion: Exploration of the relationship between metacognition and negative symptoms is rarely the focus of research reviewed here, and negative symptoms are often combined in a summary score. This approach may obscure relationships between metacognitive domains and individual negative symptoms which could help identify whether metacognition is an appropriate treatment target for specific negative symptoms. Methodological challenges around overlapping participants, variation in aggregation of negative symptom items and types of analyses used, make a strong case for use of Individual Participant Data Meta-Analysis to further elucidate these relationships.

3.2 Background

The general introduction to this thesis indicates that negative symptoms may be developed and maintained by difficulties with metacognition. This section will explore the different ways metacognition can be conceptualised and how these forms of metacognition relate to each other. This overview will demonstrate that metacognition is a multifactorial construct which is not yet clearly differentiated. Focusing on the integrative model of metacognition, the relationship between metacognition and negative symptoms will be explored and rationale for a systematic review of studies exploring the relationship between negative symptoms and metacognition will be presented.

3.2.1 Different ways of conceptualising metacognition

The previous chapters highlight that there are many cognitive capacities subsumed within the broader construct of metacognition ranging from discrete to more synthetic capacities. Most broadly, these capacities are generally concerned with an individual's capacity for "thinking about thinking" (Flavell,

1979). Here we will go into more detail around the ways in which the more synthetic capacities as described by Lysaker and Dimaggio (2014) are differentiated from more discrete forms of metacognition.

At the most discrete end of the spectrum, metacognition refers to an individual's ability to recognise one's own mental and emotional states as well as those of others and to use these to infer others' or one's own intentions (Lysaker et al., 2011i). Theory of mind (ToM), for example, is a discrete metacognitive capacity in that ToM tasks generally involve inferring what the other is thinking in relation to a specific judgement, given a realistic understanding of the relevant information available (Brüne, 2005). Over time, repeated exposure to situations requiring ToM inferences lead to context-relevant understanding that supports more refined responses based on knowledge of a specific person or situation (Gilleen et al., 2016). Over time these discrete judgements are assimilated into larger, more integrated, and thus more complex views of the world, as in more synthetic forms of metacognition (Lysaker et al., 2013a). This view is mirrored in the Nelson (1990) model of metacognition; where the content of discrete cognitive capacities form one level of metacognition (the object level), are reflected on as part of an overall appraisal (at the meta level).

Discrete metacognitive capacities are also described as representations of social cognition. Lysaker et al. (2010a) argues that measures of theory of mind can be considered a measure of social cognition in that individuals make inferences about the minds of another which has an inherent social context. These tasks also often refer to online cognitive judgements about mental states which share a greater focus on the accuracy of judgements (usually about the knowledge another actor holds) rather than integration of complex affective information. In this sense Theory of Mind tasks encapsulate social cognition as they assess an individuals' ability to make judgements based on social inferences. However, Theory of Mind also represents a lower level of the metacognitive hierarchy: these inferences inform higher-order appraisal, and are also potentially influenced by the capacity to hold a representation of the self to use as a template to allow individuals to form inferences about another. It is recognised that there is limited understanding of how these hierarchical capacities are distinct from each other, and disagreement exists about what the most

appropriate terminology would be. For the purposes of this thesis, we will broadly label Theory of Mind, and any other accuracy-based measures of inferences about others, as discrete metacognitive capacities, although we acknowledge that they are inherently linked to social context.

Lysaker and Dimaggio (2014) argue that more synthetic aspects of metacognition can be represented by four constructs: Self-Reflectivity, Understanding Others' Minds, Decentration and Mastery which are measured by the Metacognition Assessment Scale – Adapted (MAS-A; Lysaker et al., 2005), first developed by Semerari et al. (2003). In contrast to the original scale, a higher score in each domain represents the ability to perform more complex metacognitive activities in this domain, which can only be awarded if the preceding capacities in that domain are achieved (Lysaker et al., 2014c). Self-reflectivity and Understanding of Other's Minds involve the capacity to represent a complex narrative that reflects one's perception of ourselves and others across time, and represent the first two domains. Decentration (the to ability recognise viewpoints as existing within the larger world, with multiple perspectives), and Mastery (the utilisation of these narratives to cope with psychological and interpersonal difficulties) represent the remaining two domains. Each of these domains are argued to be related, but operate (and can become inhibited) independently of each other (Semerari et al., 2007; Dimaggio et al., 2009).

The higher-order metacognitive capacities explored in the MAS-A are further distinguished from self- and other- referential capacities to make judgements about how cognitive capacities operate in general (Moritz & Lysaker, 2018). Examples of this include constructs labelled as "metacognitive awareness" (for example, representations of one's success employing cognitive strategies as in the Memory Awareness Rating Scale; Clare et al., 2002; which has been employed in assessments of persons with psychosis; Gilleen et al., 2011). Another example is cognitive insight (reflections on one's ability to employ self- and other- referential information when forming conclusions; Beck et al., 2004). Similarly, some metacognitive constructs focus on awareness of how an individual employs cognitive strategies (i.e. the degree of cognitive biases an individual displays; Moritz et al., 2014; and degree of attention to cognitions; Wells, 2011). Researchers argue individuals can have difficulty in some of these

capacities while not necessarily showing difficulties in others (Semerari et al., 2007).

The capacity to reflect on cognitive operations also has utility: metacognitive awareness is likely to influence generalised beliefs individuals may hold (i.e. "my interpretations of experiences are definitely right"; Beck et al., 2004), and awareness and use of assumptions which may be counterproductive (i.e. "I need to worry in order to work well"; Cartwright-Hatton & Wells, 1997). However, these metacognitions are again restricted to specific reflections being activated (or not; see Bröcker et al., 2020; Lysaker et al., 2013a; Moritz & Lysaker, 2018 for discussion). In comparison, Lysaker and Dimaggio (2014) argue that the components of the MAS-A focus on metacognition in a more integrative sense, where the process of an individual assimilating their reflections is critical to informing their views. In this sense, like a symphony orchestra produces a more complex and rich experience than the sound of individual instruments, synthetic metacognition is greater than the sum of individual judgements or cognitive strategies employed in the moment.

3.2.2 An integrative model of metacognition

The components of the MAS-A are argued to form an integrative model of metacognition (Lysaker et al., 2020d). However there is some uncertainty in the literature as to how components of metacognitive activity integrate with each other. There are moderate to high correlations between components of metacognition (with correlation coefficients between 0.39 – 0.70 (Lysaker et al., 2005; 2010a; Snethen et al., 2014; Gagen et al., 2019), but the level of dependence between constructs is unclear. Some domains show weaker associations with some components versus others (i.e. a weaker association between self-reflectivity and understanding others' minds than between self-reflectivity and mastery; Lysaker et al., 2005; 2010a; Snethen et al., 2014; Gagen et al., 2019). Given these associations, it is likely that metacognitive abilities are to some extent able to predict capacity in other metacognitive domains, despite evidence showing that they can act independently (Semerari et al., 2007). Associations between different components of the MAS-A over time should be empirically tested to assess how they impact each other.

These integrative capacities also interact with discrete metacognition abilities (Lysaker et al., 2014a; Lysaker et al., 2013a; Brüne, 2014). For example measures of emotion recognition (Hamm et al., 2012) and the ability to understand social causality (Lysaker et al., 2010a) have been positively associated with performance on the MAS-A. The spectrum of metacognitive activity may also share similar underlying associations with neurocognitive capacity, for example Theory of Mind has been linked to neurocognitive capacities including memory, attention and abstract thought (Lysaker et al., 2011i), as have MAS-A scores (Lysaker et al., 2005), particularly self-reflectivity. However while these capacities share associations there is also variance in how components of the MAS-A relate to discrete metacognitive capacities. For example, self-reflectivity was found to be more strongly associated with mental flexibility (a discrete metacognitive capacity), whereas, another discrete task, response inhibition, was associated more strongly with different synthetic metacognitive domains (Lysaker et al., 2005).

Complicating this, relationships observed between discrete and synthetic metacognition are inconsistent (i.e. theory of mind and self-reflectivity (Lysaker et al., 2011i), and the strength of association between discrete and synthetic metacognitive capacities appears to decline in individuals over time (Hamm et al., 2012; Kukla & Lysaker, 2020a). This suggests, like many constructs discussed in this thesis, that there is variance in whether the occurrence of some metacognitive abilities will lead to the co-occurrence of others. This could be regarded as evidence of equifinality (where the same level of difficulty could be experienced through multiple mechanistic pathways; Strauss & Cohen, 2017). In the spectrum of metacognitive abilities for example, difficulties with more complex capacities might be partly dependant on difficulties with more discrete abilities, but also develop in their own right. Further research is required to understand better how different types of metacognition relate to one another.

3.2.3 The relationship between metacognition and negative symptoms

We know that recovery for people with psychosis (and negative symptoms more specifically; Savill et al., 2015) is not as rare or unattainable as once believed (Lysaker & Gumley, 2010). Recovery from psychosis has been related to the ability to form complex ideas about the self as a human being within the social

world (Lysaker & Buck, 2008). Metacognitive difficulties are linked to poor social functioning, and likely increase in situations of stress (Lysaker et al., 2011f). Negative symptoms, whereby individuals experience reduced pleasure and motivation, particularly for social stimuli, have perhaps unsurprisingly also been related to poorer social functioning (Lysaker et al., 2010b). The ability to employ metacognition is likely to vary based on both the skillset of an individual and contextual factors such as time, place or person(s) being reflected upon (Lysaker et al., 2014a). Therefore, it seems possible that negative symptoms could fluctuate in response to metacognitive ability expressed moment to moment, where difficulty making sense of personally relevant situations could lead to difficulty accessing representations of potential sources of motivation and pleasure (Lysaker et al., 2013d).

Capacities across the spectrum of metacognitive abilities have been generally negatively associated with negative symptoms (i.e. lower levels of metacognition are associated with higher levels of negative symptoms). Interestingly, both discrete and synthetic metacognition show similar strength of association with negative symptoms (Vohs et al., 2014), although findings are inconsistent (Lysaker et al., 2010a) and it is possible that associations between negative symptoms and synthetic metacognition are more likely to persist over time (Hamm et al., 2012). Synthetic metacognition in particular is associated with a large proportion of the variance in negative symptoms (as much as 62%, McLeod et al., 2014), and these findings have been replicated across a range of individuals who have experienced psychoses for different lengths of time, including First Episode Psychosis (FEP) groups (MacBeth et al., 2014; Lysaker et al., 2015c). Perhaps much like the spectrum of metacognition is influenced by lower-order capacities, difficulties with discrete metacognitive tasks might leave individuals overwhelmed when interpreting others' behaviour, making synthetic metacognition more difficult (Lysaker et al., 2011i). These difficulties may then elicit unpleasant emotions, leading to the withdrawal seen as part of negative symptom presentations (Salvatore et al., 2008).

Despite increasing research, several questions remain unanswered regarding the relationship between metacognition and experiences of negative symptoms. First, it is unclear whether MAS-A domains show different patterns of correlation with negative symptoms. Of the limited research conducted, Lysaker et al.

(2011g) found that subgroups comprised based on their capacity for self-reflectivity and understanding others' minds had different associations with negative symptoms. Individuals with high awareness of oneself and others' thoughts experienced lower levels of negative symptoms than those who had difficulties with understanding others' minds alone, and the disparity was even greater with individuals showing difficulties across both domains. These metacognitive abilities were also associated with different antecedents and functional implications. For example, individuals who had difficulty understanding both their own emotions and those of others exhibited greater functional and neurocognitive impairment than those who only experienced deficits in one of these areas. Furthermore, historical factors, such as experiences of childhood sexual abuse, were more common for individuals who had difficulties in understanding others' minds (but not self-reflectivity). While these findings suggest that negative symptoms and metacognition are inversely related, they are limited in their coverage of these relationships (both in quantity of studies and in depth of coverage).

There are also measurement issues that have received limited consideration in studies to date. As mentioned in the introduction to this thesis, there are various ways negative symptoms can be conceptualised (including as a two- or five-factor structure; Strauss et al., 2019b) and it is unclear whether subdomains of negative symptoms show different patterns of association with domains of metacognition. Given that subtypes of negative symptoms have been associated with differential rates of recovery, and potentially different underlying processes (Strauss et al., 2013; Marder & Galderisi, 2017), this is an important research question. Additionally, the decentration subscale of the MAS-A encounters psychometric difficulties in that it is a relatively small scale with little room for variance which has led to skewed distribution in previous studies (Lysaker et al., 2005). Further characterisation of the data available is required to establish whether this is a consistent issue across studies and what the most optimal level of clustering for each construct is.

The small number of studies exploring this is also partially limited as several studies have grouped participants into distinct profiles, based on composite scores across two or more domains, or levels of metacognition. Generally, the variation in how understanding of both metacognition and negative symptoms

has been conceptualised and organised in existing research makes it difficult to assess the relationship between these constructs without more granular analysis. In particular, it would be helpful to understand the proportion of the available literature which has attempted to characterise these features within their samples and whether there are any consistent conclusions that can be drawn about the relationship between specific negative symptoms and metacognition.

A previous meta-analysis has already attempted to characterise the relationship between metacognition, symptoms and functioning across studies (Arnon-Ribenfeld et al., 2017). This meta-analysis confirmed that subtypes of negative symptoms are strongly related to metacognition (Cohen's D = -0.473 to -1.711) with a larger effect size than any other outcome measured. However, the review had some limitations: papers included overlapping participants in multiple studies, and only those findings representing the strongest evidence of the relationship between metacognition and an outcome for a particular study were included in the meta-analysis. While this demonstrates the importance of negative symptoms and that generally some strong relationships with metacognition have been observed, a new systematic review focused exclusively on the relationships observed between different MAS-A domains and negative symptom subtypes across studies will help make sense of this complex and sometimes contradictory literature.

3.2.4 Study 1: Aims and research questions

This study is a systematic review of the relationship between negative symptoms and metacognition. The aim is to identify all the unique reports exploring the relationship between metacognition (as measured by the MAS-A) and negative symptoms. Additionally, the review has the descriptive aims of characterising the samples and types of research conducted, and demonstrating how both negative symptoms and metacognition have been conceptualised across published reports. A narrative synthesis and description of quantitative characteristics across reports is provided to demonstrate these findings, including critical assessment of the literature and risk of bias assessment. The review is also intended to inform a subsequent Meta-Analysis of Individual Participant Data including samples which explore the relationship between metacognition and negative symptoms.

Research Questions

1. How many unique reports are there in the review period that explore the relationship between metacognition and negative symptoms?

2. What are the characteristics of studies exploring the relationship between negative symptoms and metacognition?

3. How have negative symptoms and metacognition been conceptualised across studies?

4. What is the nature of the statistical relationship between negative symptoms and metacognition across studies?

5. What is the risk of bias across the literature presented?

3.3 Methods

3.3.1 Protocol and registration

Methods were developed according to a protocol, available on PROSPERO (registration number CRD42019130678). The design followed guidelines outlined in the Cochrane Handbook for systematic reviews (Higgins & Green, 2011) and adhered to the Preferred Reporting Items for Systematic review and Meta-Analysis Protocols guidelines (PRISMA-P; Moher et al., 2015). The protocol had the dual purpose of describing both the systematic review and Individual Participant Data Meta-Analysis (IPDMA). However, the methods and criteria shown here relate to the systematic review only. For the final report, the methods and findings outlined here are reported in accordance with Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA; Moher et al., 2009) guidelines. Any deviations from the protocol are described, and recommendations from current guidelines which are not enacted and reasons for this are described.

3.3.2 Screening and eligibility criteria

Studies were selected according to the following criteria according to the Participants, Exposure, Comparator(s), Outcome(s) and Study design (PECOS) format (Morgan et al., 2018):

Participants

Adults (defined as aged 16 or above) who experienced negative symptoms.

Given the relative prominence of negative symptoms in experiences of psychosis (Chue & Lalonde, 2014), studies describing participants in terms of psychosis experiences or psychosis spectrum diagnoses were also included for the purposes of screening. This allowed reports to be identified where negative symptoms had been explored even if they were not the main focus of the study. Studies were not excluded on the basis of any other participant information (e.g. diagnosis, substance use, demographics, political affiliations or socioeconomic status).

Exposure

Measurement of negative symptoms and metacognition with standardised measures, where these constructs are defined as follows:

Negative symptoms: Deficits in experiential and expressive capacities in the specific domains of anhedonia, amotivation, asociality, alogia, and affective blunting (Kirkpatrick et al., 2006; Marder & Galderisi, 2017).

Metacognition: The multifaceted ability to integrate increasingly complex information about the self and others, in order to make sense of the social world and address psychological problems (Lysaker et al., 2014c).

Acceptable measures of negative symptoms and metacognition were not pre-determined and part of screening included determining whether measures identified measured each construct as defined above.

Comparator(s)

As the purpose of this review was to examine relationships between negative symptoms and metacognition exclusively, no comparator group or variables were appropriate for this review.

Outcomes

The primary outcome of interest was the statistical relationship between metacognition and negative symptoms. We also wanted to determine how frequently metacognition and negative symptoms were treated as a global construct or examined by symptom subtypes. To examine specific sub-profile effects, studies needed to have measured metacognition and negative symptoms using reliable and validated measures. Measures of social and occupational functioning were included as secondary outcomes to be presented descriptively.

Study Design

Only quantitative, English language publications before the last search date (30th April 2019) were included in the review. Case studies were excluded as it was anticipated that samples would overlap significantly with individual participants in larger studies included in the review and because there would be little additional benefit to extracting data regarding such small samples.

There were no restrictions on the aim(s), setting, length of follow up or publication status of any reports. Reports outside the English language were excluded due to lack of ability or resources to translate reports.

3.3.3 Search strategy

Broad search terms around experiences of psychosis, negative symptoms, and metacognition were used to maximise the identification of relevant papers. Adhering to Cochrane Collaboration Guidelines (Higgins & Green, 2011), the search string for each information source was devised to ensure a comprehensive search using free-text keywords and database specific index terms where possible. No restrictions were placed on the search. The following databases were searched:

- PsycINFO (1887- present, updated weekly) via EBSCOhost

- MEDLINE (Ovid MEDLINE® Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE® Daily, Ovid MEDLINE and Versions® - 1946 – present, updated daily and weekly) via Ovid

- EMBASE (1947 – present, updated daily) via Ovid

- The Cochrane Database of Systematic Reviews (2007 – present) via Wiley Online Library.

- The Cochrane Central Register of Controlled Trials via Wiley Online Library (1966 – present) via Wiley Online Library

Appendix 1 includes the search string for PsycINFO. An update of the first search (May 2018) was conducted in April 2019. Hand-searching of the reference lists of included reports and relevant reviews was also conducted, as was forward citation searching of included reports using Web of Science and Google Scholar. Grey literature including Google Scholar, Open Grey, and the Directory of Open Access Journals were also searched using the free-text keywords to try to identify any missing records and investigate potential sources. Authors from included studies were contacted to determine if there were any other data or reports that should be included. The development of the systematic search criteria was supported by an academic librarian at the University of Glasgow, who has appropriate methodological expertise, and the primary reviewer's supervisory team who possess appropriate subject knowledge.

3.3.4 Study selection

Search results were extracted from each database (including title, author, and publication information) and uploaded into Endnote (version x9) where the automatic de-duplication function was used for exact copies of references, and almost exact copies were manually compared to complete this process. Studies were screened for eligibility at title and abstract, followed by full-text review of records to determine whether they met, or potentially met, inclusion criteria. At each stage, 100% of the screening was completed by the primary reviewer (NM)

and a second reviewer (WA) completed independent screening, blind to primary reviewer categorisations, of a randomly selected 10% of the studies (selected using random list generation within Excel). Blinding of the primary reviewer to journal titles and author information was not possible given their previous conducting of the search; and it was too resource intensive in the context of this thesis to adequately blind reviewer 2 to this information also.

Reviewers ascribed “yes”, “no”, or “maybe” to whether studies met eligibility criteria for each studies, with those categorised as “no” being excluded at title and abstract level. It was pre-specified that reviewers required Cohen’s Kappa measure of inter-rater agreement of 0.80 or above to move to the next stage of the review (based on this being identified as a high level of inter-rater reliability; Mokkink et al., 2016). Following calibration inter-rater agreement between reviewer 1 and reviewer 2 at title and abstract level was k=0.91 indicating almost perfect agreement. The level of agreement for full-text reviews was k=0.89 indicating almost perfect agreement also. Reviewers discussed remaining disagreements until a consensus was achieved.

There were several reports that provided insufficient information to determine whether they met inclusion criteria. In these instances, other works referencing these papers, and original authors were contacted to gain further information. Where reports were indicated not to meet inclusion criteria from further information, or where there were no replies from the original authors these studies were excluded from the review.

3.3.5 Data extraction

A data extraction sheet was created with Microsoft Excel which allowed recording of study publication information and components of the study relevant to this review including aims, methodology, results, and relevant discussion points. Original authors were also contacted to gain further information not provided in the report, and to explore whether records sharing a high degree of similarity were of the same dataset. Study authors were contacted a maximum of three times if there was no reply. Again, because of the reviewers’ involvement in previous

aspects of the study, they were not blind to journal titles and study author information. The primary reviewer extracted data from 100% of the eligible reports and the second reviewer independently extracted data from 10% of the eligible reports (identified by a randomised list generated in Excel), blind to the primary reviewer's outputs. Reviewer outputs were checked for similarity and any discrepancies were resolved by discussion until a consensus was reached. It was pre-specified that 80% agreement was required to proceed to analyses, and following calibration (for example, ensuring data was extracted in the appropriate sections of the form), reviewers achieved 85% agreement and the remaining discrepancies were resolved through discussion.

3.3.6 Risk of bias assessment

Included studies were assessed using the Quality in Prognosis Studies (QUIPS) tool (Hayden et al., 2013), which assesses each relevant domain which could present a risk of bias. Specifically, population representativeness, measurement methods, attrition, confounding, statistical analysis, and reporting were all assessed in this study. The tool also allows researchers to identify key criteria for each domain which should be demonstrated by each study report to achieve a low risk of bias rating, which was adapted in consideration of the inclusion criteria. Additionally, in line with the tool guidelines, two review specific items were added to allow reviewers to systematically address any funding and conflict of interest items noted and to report any differences between published journal articles and conference abstracts, theses, or letters to the editor of the same study. Two reviewers (NM and SA) completed risk of bias assessment for 100% of the included studies independently of each other. Following calibration the reviewers achieved a Cohen's Kappa = 0.77 indicating substantial agreement (McHugh, 2012). Remaining discrepancies were resolved following discussion and arbitration with a third independent reviewer (HM).

3.3.7 Analysis

Included studies were described using narrative synthesis in line with existing guidance (Popay et al., 2006). Additionally, in line with PRISMA guidelines (Liberati

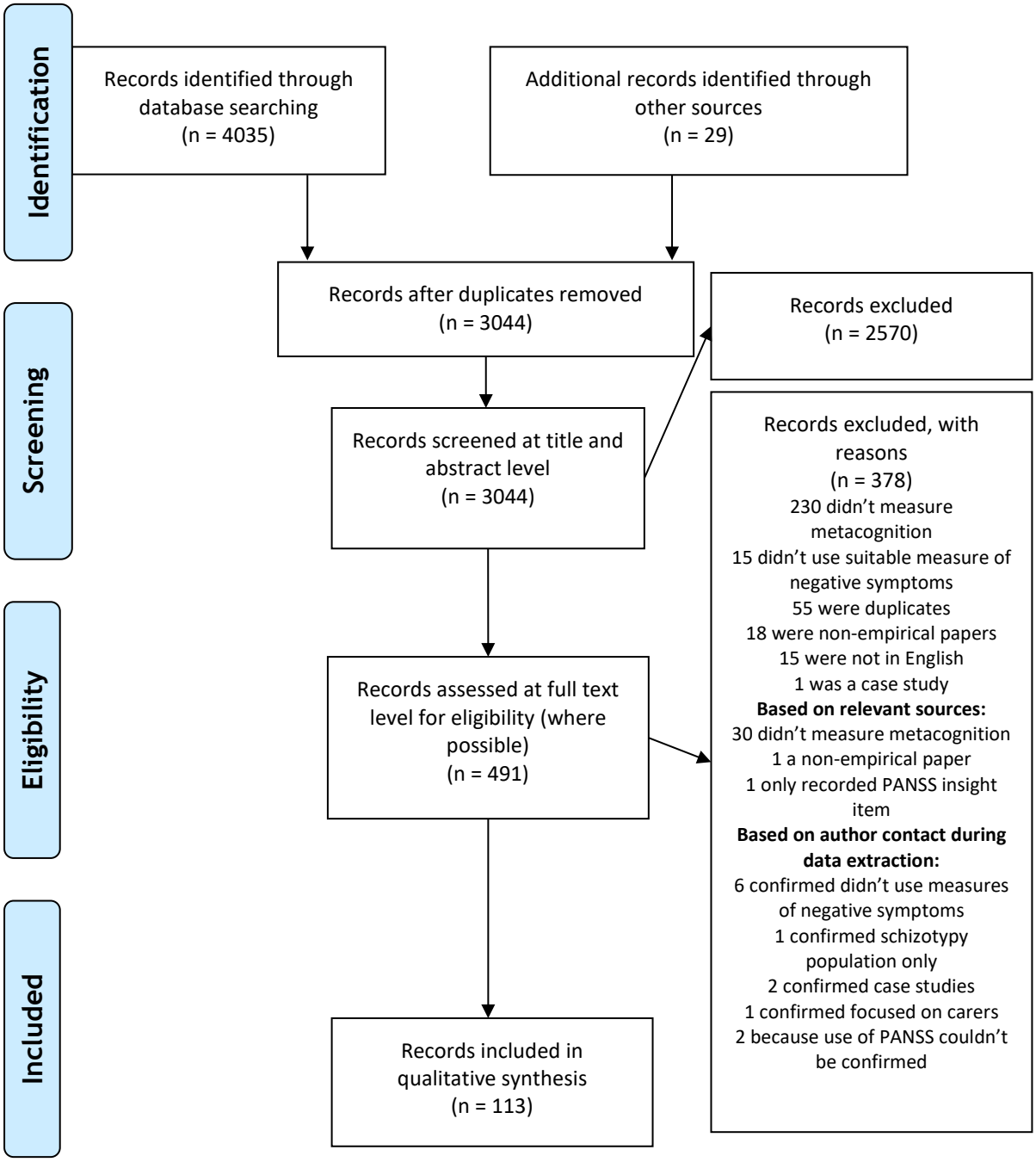
et al., 2009), the results of study selection and quantitative characteristics of the included reports were described to systematically contextualise the statements regarding similarities and differences between studies. Given that alongside characterising the sample of studies exploring negative symptoms and metacognition, the systematic review aimed to inform a subsequent IPDMA, no meta-analyses of the aggregate data across reports was conducted. It was further anticipated that as studies which did not focus on the relationship between negative symptoms and metacognition could still be eligible for inclusion (provided that measures of these constructs were sufficiently described).

3.4 Results

3.4.1 Search results

There were 4089 total returns from all included academic databases. For the purposes of illustration we have combined the results both the original search and the update in Figure 3.1. Following the 4035 records identified via database searching, 29 further records were identified from backwards and forwards citation searching. Seventeen theses and twelve journal articles were identified via handsearching of Google Scholar using keywords. Neither Open Grey or the Directory of Open Access Journals returned any additional relevant search results. Two further records were identified via author contact which could not be included as they were not in English although they appeared to meet all other inclusion criteria.

Figure 3.1: PRISMA flow diagram of studies identified from both searches



After de-duplication a further 2570 records were excluded with the main reason being the identification of further non-exact duplicate records. This left 491 records to be screened at full text level. Initially 366 records were excluded with the main reason being metacognition was not measured as defined; however several records met did not meet multiple aspects of inclusion criteria. A further 12 reports were excluded during data extraction because it was confirmed via

further author contact that they didn't meet inclusion criteria, or in 2 cases, ability to meet inclusion criteria could not be confirmed. This resulted in a 113 final reports - comprising 7 theses, 30 conference abstracts, 1 letter to the editor, and 79 journal articles - being compared to determine whether they utilised the same datasets.

3.4.2 Identifying multiple study reports

Reports were identified as corresponding to the same dataset by comparing matching information across records, including measures and interventions used, and recruitment and data collection procedures. Reports that stated the exact same aims, measures used, and data reported (exclusively conference abstracts or theses with the same information as journal articles) were judged as being of the same piece of research and were combined for the purposes of this review. Original authors confirmed these judgements. This resulted in 85 unique reports being included which are summarised in Appendix 2. A further 10 conference abstracts are described which also belong to these datasets, however, as their aims or methods were generally consistent with other full text reports and they offer limited information they are not discussed further in this review.

Matching reports to unique datasets would not be possible without co-author input. We identified 32 unique datasets and an estimated 1,623 unique participants across studies based upon the maximum sample size reported in press for each dataset (Appendix 3). The second England sample were recruited and reported on concurrently with participants completing follow up from England sample 1, following author confirmation we describe their sample using the total minus those participants from England sample 1. Furthermore, although most of the 68 secondary data analyses papers reported that this was an analysis of existing data, only 29 reported where the data originated from. Furthermore, seven articles which analysed secondary data did not specify this or reporting was unclear (Abu-Akel et al., 2015; Bo et al., 2013; Bo et al., 2014; Buck et al., 2012; Lysaker et al., 2014d; Lysaker et al., 2008; Popolo et al., 2017; Vohs et al., 2015c). It was also unclear where one thesis and one published article were of the same data (Mitchell et al., 2012; Reilly, 2011). Additionally,

most reports did not specify where results were a new analysis of existing data, or new data collected from individuals already contributing to previous studies. Multiple reports of the same datasets also varied in sample size due to the data completeness for variables of interest resulting in participants being dropped from some analyses and not others.

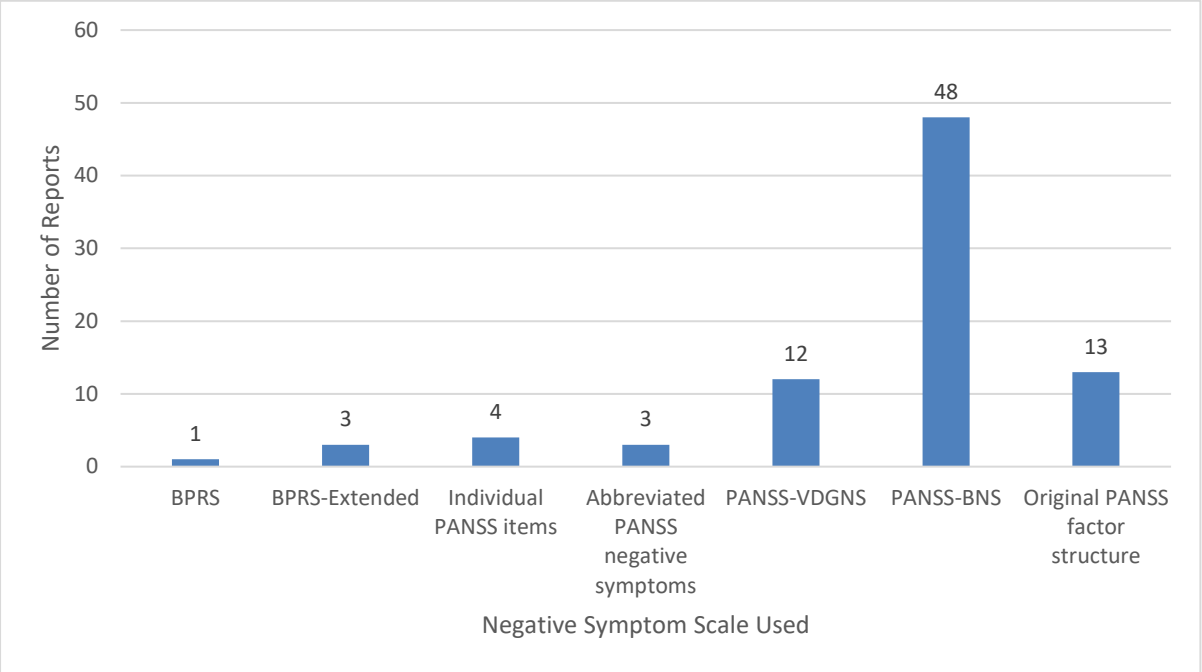
3.4.3 Characteristics of the reports

Most data collected on negative symptoms and metacognition were drawn from intervention studies (although these reports included baseline data only and did not explore the interventions themselves) and most data came from USA sites. The comparisons are largely cross-sectional and investigate the ability of specific variables to predict metacognition, with some studies not directly comparing negative symptoms and metacognition, but rather symptoms being analysed as a covariate. Fifty-nine reports specified a focus on symptoms in their hypotheses, with 34 highlighting negative symptoms specifically as an outcome of interest. Only nine studies focused on individual negative symptoms, including anhedonia, or more specifically consummatory/anticipatory deficits (Buck et al., 2014; Luther et al., 2016a); blunted affect and emotional withdrawal (Bo et al., 2015); intrinsic motivation (Luther et al., 2016a; 2016b; 2020; Tas et al., 2012b; Vohs & Lysaker, 2014); and deficits in “specific negative symptoms” (Nicolò et al., 2012; Austin et al., 2019).

Metacognition was specified as an outcome of interest across all records, with only two studies (Abu-Akel & Bo, 2013; Bo et al., 2013) referring to metacognition and mentalisation (a related term which is often used to describe the capacity for understanding oneself and others' mental states based on attachment theory; Ridenour et al., 2019) interchangeably. Of these, eight reports used a measure other than the Metacognition Assessment Scale (MAS-A) developed by Lysaker et al. (2005); including 4 reports using the Metacognition Assessment Interview (MAI; Davies et al., 2017; Wright et al., 2019b; 2019a; 2020b), and four using the Revised version of the MAS (MAS-R; Reilly, 2011; Mitchell et al., 2012; MacBeth et al., 2014; 2016). Fifty studies specified the aim of examining specific metacognitive subdomains.

The Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987) was the most common measure of negative symptoms (n=81 reports). Four reports used variants of the Brief Psychiatric Rating Scale (BPRS; Bargenquast & Schweitzer, 2014; Massé & Lecomte, 2015; Popolo et al., 2017; Schweitzer et al., 2017). The studies specifying an interest in individual negative symptoms either used specific measures (e.g. of intrinsic motivation or anhedonia) or reported on individual PANSS items (e.g. blunted affect, emotional withdrawal). Of the 81 reports using the PANSS, 63 used an alternative to the original PANSS factor structure to analyse symptom data (e.g. Bell et al., 1994; and van der Gaag et al., 2006 factor structures; PANSS-BNS and PANSS-VDGNS respectively). Thirteen reports used the original negative symptoms subscale (PANSS-ONS; Kay et al., 1987), and one study had not yet completed PANSS data analysis. The remaining studies assessed individual items (e.g. Buck et al., 2012; Minor et al., 2015c), or used overall PANSS scores as a cut-off to determine if individuals had eligible levels of symptom severity (Davis et al., 2011; van Kleef et al., 2015). The different combinations of items contributing to negative symptoms analyses (summarised in Figure 3.2) creates different possible total scores making it problematic for aggregating these data. Additionally, 17 reports did not specify which factor structure they used to measure negative symptoms.

Figure 3.2: Negative symptom structures measured across reports



BPRS: Brief Psychiatric Rating Scale; **PANSS:** Positive And Negative Syndrome Scale; **VDGNS:** Van der Gaag et al. (2006) Negative Symptoms factor structure; **BNS:** Bell Negative Symptoms factor structre

NB: The use of PANSS in one dataset (Vernal et al., 2018) does not contribute to this figure as results were not analysed at time of writing.

3.4.4 Characteristics of the included samples

Sixty-six reports provided negative symptom data (31 of these included hypotheses about negative symptoms). Two studies reported no negative symptom subscale data but did include negative symptoms in covariate analyses (Kukla et al., 2013; Rabin et al., 2014). Four studies reported BPRS, BPRS-Extended (BPRS-E) and Intrinsic Motivation measures. It is not possible to derive a single quantitative summary of the range of negative symptom scores present in the remaining 62 reports using the PANSS because of the various factor structures used. Three studies also reported individual PANSS items and a further three reported an abbreviated scale made up of a small number of items. Additionally, 14 studies reported negative symptom data per group of participants clustered together based on additional characteristics (e.g. intervention group at baseline, metacognition levels), making it impossible to extract negative symptom severity

scores independent of these additional constructs. Table 3.1 gives the range of *average* negative symptom scores reported across studies.

Table 3.1: A quantitative summary of PANSS Negative Symptom scores reported across studies

PANSS Negative Symptom (PANSS-NS) factor structure	Bell et al. (1994) (PANSS-BNS; PTSR 8-56)	Original (PANSS-ONS; PTSR 7-49)	Van Der Gaag et al. (2006) (PANSS-VDGNS; PTSR 2-62)
Total number of reports using PANSS factor structure specified	48	13	12
Number of studies reporting data	39	11	12
Reported symptom range of mean scores for negative subscale	13.9 - 24.5	10.97 – 22.2	12.54 – 19.41

PANSS-NS: PANSS Negative Symptom Subscale Score, **PANSS-BNS:** Bell et al. (1994) negative symptoms factor structure score, **PANSS-ONS:** Kay et al. (1987) original negative symptom subscale score, **PANSS-VDGNS:** van der Gaag et al. (2006) negative symptoms factor structure score, **PTSR:** Possible Total Score Range

The range of MAS-A scores reported across subdomains and the total score are highlighted in Table 3.2, based on 71 studies which gave descriptive data for at least some elements of the MAS-A. Seven studies with MAS-A subscale-specific hypotheses did not descriptively summarise MAS-A components, and instead some grouped participants by high, intermediate and low scores in these domains (e.g. Bonfils et al., 2018; Davis et al., 2011). Seven studies excluded the decentration subscale from their description of the MAS-A; with only 3 studies giving a rationale for this. This complicates interpretations of total metacognition levels because it is then unclear whether these scores include decentration. Similar to negative symptoms, some studies also described MAS-A scores for participants grouped on other variables, leading to more extreme scores (i.e. high achievers on a learning task in one study (Tas et al., 2012b) scored higher total metacognition than is reported in any other study: 16.55).

Table 3.2: MAS-A characteristics across reports and ranges reported

	Self-reflectivity (range 0-9)	Understanding Others' Minds (range 0-9)	Decentration (range 0-3)	Mastery (range 0-9)	Total MAS-A score (range 0-28)
Number of studies with metacognition-specific hypotheses	27	20	16	25	25
Number of studies reporting MAS-A subscale scores	47	41	34	46	48
Reported range (means across studies)	3.375-5.51	2.27-4.43	0.36-1.69	1.77-4.75	8.48-14.6

3.4.5 Findings reported across studies

Sixty-two studies reported analyses of negative symptoms and metacognition and 22 did not report any analyses relevant to the aims of this review. Of the relevant analyses, 35 reported a direct correlation coefficient between negative symptoms and metacognition (a full breakdown of studies is provided in Appendix 4). Remaining analyses including secondary outcomes and their relationship to metacognition and negative symptoms are summarised in Appendix 5. There is insufficient homogeneity in the analyses conducted to perform a meta-analysis as part of this review, therefore a narrative summary is given only. In addition to the existing summary tables in the appendices, Table 3.3 and 3.4 summarise the study characteristics and findings of research making a direct comparison between negative symptoms and metacognition. Table 3.5 describes the range of correlations (including Pearson's and Spearman's coefficients) between subtypes of metacognition and total negative symptom measures and their statistical significance. However, given the different factor structures used there are different items contributing to analyses across studies. As only one study (Reilly, 2011) used Kendall's Tau as a measure of association (showing a relationship of -0.02 - -0.17 between negative symptoms and MAS-A subtypes) we refer interested readers to this paper for further comparison.

Table 3.3: Cross-sectional associations between negative symptoms and metacognition

Major Study, Country	Sub /Secondary analyses	Does study hypothesis specify interest in symptoms?	Metacognition measures	Negative symptom measure(s)	Sample size (of schizophrenia sample)	Type of sample	Findings
Massé and Lecomte (2015), Canada		No	MAS-A (excl. decentration)	BPRS-E (Negative)	50	FEP	No significant difference across participants grouped by metacognitive profile on BRPS negative scores.
Lysaker et al. (2018), Chile		Negative symptoms	MAS-A	PANSS-BNS	26	People with schizophrenia	Significant correlation between UOM, Mastery and total metacognition with PANSS-NS, no other significant relationships.
Abu-Akel and Bo (2013), Denmark		No	MAS-A total, SR and UOM only (alternative scoring)	PANSS-NS – abbreviated	42	Patients with schizophrenia	No significant correlations between PANSS-NS abbreviated version and MAS-A.
	Abu-Akel et al. (2015)	No	MAS-A (excl. decentration, alternative scoring)	PANSS-NS – abbreviated	79	Forensic patients with schizophrenia	No significant correlations between PANSS-NS abbreviated version and MAS-A. Significant

							correlation between MAS-A subscales and MAS-A Total.
	Bo et al. (2015)	Individual negative symptoms	MAS-A (alternative scoring)	PANSS (blunted affect (N1), passive/ apathetic social withdrawal (N4))	79	Primarily criminal and violent patients with schizophrenia	Significant correlation between decentration and passive/apathetic social withdrawal – no other significant correlations between PANSS-NS items and MAS-A subscales or total score.
Trauelsen et al. (2016), Denmark		Negative symptoms	MAS-A	PANSS-VDGNS	97	FEP	PANSS-NS significantly correlated with MAS-A total score and all subscales.
	Trauelsen et al. (2019)	Negative symptoms	MAS-A	PANSS-VDGNS	92	Non-affective FEP	MAS-A Total and subscale scores all significantly correlated with PANSS-NS and with each other.
Bröcker et al (2017), Germany		No	MAS-A	PANSS-VDGNS	22	Individuals with Schizophrenia Spectrum Disorders (SSDs).	No significant correlations between MAS-A subscales and total score and PANSS-NS.
Rabin et al. (2014),		Negative symptoms	SR and UOM	PANSS-ONS	39	Persons with schizophrenia	SR and UOM significantly correlated with PANSS-NS and with each other.

Israel							
Nicolò et al. (2012), Italy		Individual negative symptoms	MAS-A (excl. decentration)	PANSS (blunted affect (N1), emotional withdrawal (N2), and disturbance of volition(G13))	45	Outpatients with schizophrenia	Controlling for age and education, blunted affect significantly correlated with SR and UOM, emotional withdrawal significantly correlated with SR, and disturbance of volition significantly correlated with SR and total score. No other significant correlations found.
	Popolo et al. (2017)	Negative symptoms	MAS-A	BPRS (Negative)	26	Patients with schizophrenia	BRPS Withdrawal/ retardation subscale score correlated significantly with SR and UOM and total score. No significant correlations with Decentration and Masterysubscales.
Van Kleef et al. (2015), Netherlands		Symptoms	MAS-A	PANSS-ONS	52	People with schizophrenia	UOM and total score correlated significantly with PANSS-NS, no other subscales significantly correlated.

Mitchell et al. (2012), Scotland		No	MAS-R	PANSS-ONS	29	People with schizophrenia with/without a history of interpersonal violence	PANSS-NS was significantly correlated with the MAS-R Understanding Others' Minds and mastery subscales.
MacBeth et al. (2014), Scotland		Negative symptoms	MAS-R	PANSS-VDGNS	34	FEP	Significant relationship between MAS-R Understanding Other's Minds subscale and PANSS-NS.
Tas et al (2014), Turkey		No	MAS-A	PANSS-ONS	30	People with schizophrenia	No significant correlations between PANSS-NS and MAS-A subscales.
Lysaker et al. (2005), USA		Negative symptoms	MAS-A (excl. decentration)	PANSS (blunted affect (N1), emotional withdrawal (N2), disturbance of volition (G13))	61	People with schizophrenia	Significant relationship between MAS-A subscales with emotional withdrawal, but not with blunted affect or disturbance of volition.
Buck et al. (2012), USA		Symptoms	Mastery	PANSS-BNS	40	People with schizophrenia	Found individuals grouped by their level of mastery had significantly different PANSS-NS scores.
	Fridberg et al. (2010)	Symptoms	MAS-A	PANSS-BNS	79	People with schizophrenia	Significant correlation between SR and PANSS NS.

	Lysaker et al. (2007)	Symptoms	SR and Decentration	PANSS-VDGNS	69	People with schizophrenia	Significant relationship between SR and PANSS-NS, but not Decentration.
	Lysaker et al. (2010a)	Symptoms	MAS-A (excl. Decentration)	PANSS-BNS	102	People with schizophrenia	No significant relationship between MAS-A total score and subscales with PANSS-NS.
	Lysaker et al. (2010b)	No	Mastery	PANSS-BNS	102	Persons with schizophrenia	No significant relationship between Mastery and PANSS-NS.
	Lysaker et al. (2012)	Negative symptoms	MAS-A	PANSS-BNS	95	People with schizophrenia	Factor analytical structure of metacognitive constructs (BCIS and MAS-A total) not significantly related to PANSS-NS.
Minor and Lysaker (2014), USA		Symptoms	MAS-A	PANSS-BNS	68	People with schizophrenia	Significant negative correlation between MAS-A Total score and SR and Mastery, and PANSS-NS, but not UOM and Decentration.
Vohs et al. (2014), USA		Symptoms	MAS-A	PANSS-BNS	98	FEP/MEP sample	PANSS-NS significantly correlated with MAS-A total score and all

							subscales except Decentration.
	Vohs et al. (2015b)	Symptoms	MAS-A	PANSS-BNS	40	FEP	UOM, Mastery and total metacognition significantly correlated with PANSS-NS. SR subscale appears not significantly correlated as not reported.
Bonfils et al. (2018), USA		No	MAS-A	PANSS-BNS	56	People with schizophrenia	Significant correlation between SR and PANSS-NS.
Bonfils (2017), USA		No	MAS-A (total)	PANSS-BNS	58	People with schizophrenia	No significant correlation between MAS-A total score and PANSS-NS.
	Bonfils et al. (2019)	No	MAS-A	PANSS-BNS	58	People with schizophrenia or schizoaffective disorder	PANSS-NS significantly correlated with MAS-A total score and SR, no other significant correlations identified.
Luther et al. (2019), USA		Individual negative symptoms	MAS-A	QLS motivation index Motivation and Pleasure – Self-Report scale	56	People with SSDs.	No measure of motivation was significantly associated with MAS-A total.

				Clinical Assessment Interview for Negative Symptoms			
MacBeth et al. (2016)*, Scotland		Negative symptoms	MAS-R	PANSS-VDGNS	34	FEP	No significant correlations between MAS-A items and PANSS-NS.
Snethen et al. (2014)*, USA		Negative symptoms	MAS-A	PANSS-BNS	44	People with schizophrenia	No significant correlations between MAS-A subscales and PANSS-NS.
Luther et al. (2016)*, USA		Individual negative symptoms	MAS-A	PANSS-BNS Quality of Life Scale Motivation Index	175	People with schizophrenia	Higher metacognition significantly predicted higher levels of intrinsic motivation
Gagen et al. (2019)*, USA		Negative symptoms	MAS-A	PANSS-BNS	334	People with schizophrenia	PANSS-NS significantly negatively correlated with MAS-A total score.

BCIS: Beck Cognitive Insight Scale; **BPRS(-E):** Brief Psychiatric Rating Scale(- Extended); **FEP:** First Episode Psychosis; **G13:** Disturbance of volition; **MAS-A:** Metacognition Assessment Scale – Adapted; **MAS-R:** MAS – Revised; **MEP:** Multiple Episode Psychosis; **N1:** Blunted affect; **N2:** Emotional withdrawal; **N4:** Passive/apathetic social withdrawal; **PANSS(-NS):** Positive and Negative Syndrome Scale(- Negative Scale); **PANSS-BNS:** PANSS (Bell factor structure) Negative Scale; **PANSS-ONS:** PANSS (Original factor structure) Negative Scale; **PANSS-VDGNS:** PANSS (Van der Gaag factor structure) Negative Scale; **QLS:** Quality of Life Scale; S**R:** Self-Reflectivity; **SSDs:** Schizophrenia Spectrum Disorders; **UOM:** Understanding Other's Minds

Reports marked (*) include overlapping participants from several other datasets

Table 3.4: Longitudinal associations between negative symptoms and metacognition

Major Study, Country	Does study hypothesis specify interest in symptoms?	Metacognition Measures	Negative Symptom Measure(s)	Sample size (of schizophrenia sample)	Type of sample	Findings
Austin et al. (2019), Denmark	Individual negative symptoms	MAS-A	PANSS-VDGNS (and Harvey et al. 2017 two factor model; and individual items blunted affect (N1), emotional withdrawal (N2), poor rapport (N3), passivity (N4) and alogia (N6))	59	FEP	Expressive negative symptom domain (composed of PANSS-NS items N1, N3 and N6) significantly correlated with SR and Mastery, no other significant correlations, and experiential domain (N1 and N4) was not significantly correlated with any MAS-A subscales. PANSS N1, N2, N3, N4 and N6, expressive and experiential components, and total score, all significantly correlated with MAS-A Total score at baseline, N1, N3 and N6, total score, and expressive component all significantly correlated at follow-up. Significant relationship retained for N1 and N3 when controlling for baseline negative symptoms.
Wright et al. (2019), England	Negative symptoms	MAI (total)	PANSS-ONS	26	FEP	MAI baseline and follow-up total composite scores significantly correlated with PANSS-NS baseline and follow-up scores.

McLeod et al. (2014), Scotland	Negative symptoms	MAS-A	PANSS-ONS	45	People with early psychosis	Decentration and Mastery subscales significantly correlated with PANSS-NS at 6 months (SR and UOM not) no significant correlations at 12 months. Addition of MAS-A scores to predictive models of negative symptoms explained 62% of variance at 6 months and same model explained 38% of variance at 12 months.
Breustedt et al. (2017), Scotland	No	MAS-A	PANSS-ONS	12	Individuals experiencing acute psychosis	Significant correlations between Decentration and total score with PANSS-NS.
Tas et al. (2012), Turkey	Individual negative symptoms	MAS-A	PANSS-ONS Intrinsic Motivation Inventory	30	Patients with symptomatically remitted schizophrenia	All subdomains of metacognition significantly correlated with all subdomains of intrinsic motivation, except interest and enjoyment.
Davis et al. (2011), USA	No	MAS-A (Mastery)	PANSS-BNS	63	People with schizophrenia	Found individuals grouped by their level of mastery had significantly different PANSS-NS scores.
Hamm et al. (2012), USA	Negative symptoms	MAS-A (Total)	PANSS-BNS	49	People with schizophrenia	Significant correlation between MAS-A Total scores and PANSS-NS at baseline and 6 months.
Luther et al. (2016), USA	Individual negative symptoms	MAS-A	PANSS-BNS QLS-MI Temporal Experience of Pleasure Scale	51	Individuals with SSDs	Reduced baseline motivations significantly related to increased baseline PANSS-NS and lower metacognition. Decreased motivation at 6-month follow up also associated with

						decreased baseline motivation, anticipatory pleasure and metacognition amongst other factors. Metacognition was a significant contributor to a model predicting prospective motivation.
Lysaker et al. (2015), USA	Negative symptoms	MAS-A (Total)	PANSS-BNS	53	People with schizophrenia	When participants grouped by metacognition level (low, moderate, high), the low metacognition group had significantly higher PANSS-NS scores. Participants with low MAS-A scores at baseline had a trajectory of worsening negative symptoms over time. Results were consistent across all treatment groups.
Vohs and Lysaker (2014), USA	Individual negative symptoms	MAS-A	PANSS-BNS QLS-MI	75	Individuals with prolonged schizophrenia	No significant differences on PANSS-NS for participants grouped by levels of low, intermediate and high mastery. Mastery significantly correlated with intrinsic motivation over time, and there were significant differences across mastery groups on intrinsic motivation at all timepoints.

FEP: First Episode Psychosis; **MAI:** Metacognition Assessment Interview; **MAS-A:** Metacognition Assessment Scale – Adapted; **N1:** Blunted affect; **N2:** Emotional withdrawal; **N3:** Poor rapport; **N4:** Passive/apathetic social withdrawal; **N6:** Alogia; **PANSS(-NS):** Positive and Negative Syndrome Scale(- Negative Scale); **PANSS-BNS:** PANSS (Bell factor structre) Negative Scale; **PANSS-ONS:** PANSS (Original factor structure) Negative Scale; **PANSS-VDGNS:** PANSS (Van der Gaag factor structure) Negative Scale; **QLS-MI:** Quality of Life Scale - Motivation Index; **SR:** Self-Reflectivity; **SSDs:** Schizophrenia Spectrum Disorders; **UOM:** Understanding Other's Minds

Table 3.5: Summary of correlation comparisons between negative symptoms and domains of metacognition

		Self-Reflectivity N (% significant)	Understanding Others' Minds N (% significant)	Decentration N (% significant)	Mastery N (% significant)	Total Metacognition N (% significant)
Total Negative symptom Comparisons		25 (44%)	24 (50%)	17 (41.18%)	23 (39.13%)	24 (66.67%)
Range of coefficients (for statistically significant relationships only)	**Min**	-0.23	-0.29	-0.422	-0.29	-0.28
	Max	-0.54	-0.60	0.88	-0.70	-0.64

In summary, significant findings of a relationship between subscales of metacognition and summed measures of negative symptoms were not consistently observed (Leonhardt et al., 2015), and when they were, the strength of association ranged from small to large. Only the relationship between decentration and negative symptoms demonstrated a positive value in one study. These relationships otherwise demonstrated an inverse association. Total metacognition was significantly associated with negative symptoms more than any of the metacognitive subscale domain scores, and the sum of domain-specific correlation coefficients was not equal to correlation coefficients for MAS-A total. No one metacognitive domain emerged as consistently and significantly related to total negative symptoms.

Regression and covariate analyses were also mixed, but the general pattern of results was similar; for example, better metacognition predicted higher levels of intrinsic motivation (Luther et al., 2016b) and lower levels of total negative symptoms (Hamm et al., 2012). In one longitudinal study, an inverse relationship between negative symptoms and metacognition persisted over 6 months, independent of demographics (Nicolò et al., 2012). Similarly, relationships between negative symptoms and MAS-R subscales also showed a range of significant and non-significant relationships (MacBeth et al., 2016; Mitchell et al., 2012). The only study with relevant analyses using the Metacognition Assessment Interview (MAI) also showed a significant relationship between PANSS total negative symptoms and metacognition over time (Wright et al., 2019a).

Only five reports give comparisons of domains of metacognition and specific negative symptoms. One study suggested individual metacognitive domains were positively related to different elements of intrinsic motivation, but like other studies, no single metacognitive domain emerged as more consistently and strongly related to negative symptom items than any other (Tas et al., 2012b). As detailed further in the Appendices, individual PANSS negative symptom items were often not significantly correlated with MAS-A subscale scores. Only one study (Austin et al., 2019) summarised relationships between individual items clustered by expressive and experiential deficits (as suggested by Harvey et al., 2017) as well as individual negative symptom relationships. Expressive negative symptoms when treated individually and when grouped together appeared more consistently associated with MAS-A scores at baseline and follow-up than experiential negative symptoms. There is limited evidence to draw a clear

conclusion about the relationship between metacognitive domains and specific negative symptoms.

Several studies grouped their participants by a range of variables including metacognitive levels and composite scores of various symptom domains. Studies clustering participants into low, medium, and high levels of mastery found a range of significant and non-significant relationships between metacognition and negative symptoms (e.g. Vohs & Lysaker, 2014; Davis et al., 2011). Similarly, participants grouped into low, high, and medium levels of total metacognition also showed significant differences on negative symptom scores (Lysaker et al., 2015c). Of the two studies grouping participants by metacognitive profiles (high, mixed or low metacognitive abilities, and composite self-reflectivity/decentration scores respectively), both significant and non-significant associations were found (Massé & Lecomte, 2015; Lysaker et al., 2007). Given that clustering likely differs based on sample size (Liu et al., 2008), and negative symptoms experiences are relatively heterogeneous (Stiekema et al., 2018b), it is unclear whether clustering approaches have contributed to the inconsistency of results and so it is difficult to draw comparisons across studies investigating the relationship between metacognition and negative symptoms.

3.4.6 Risk of Bias assessment

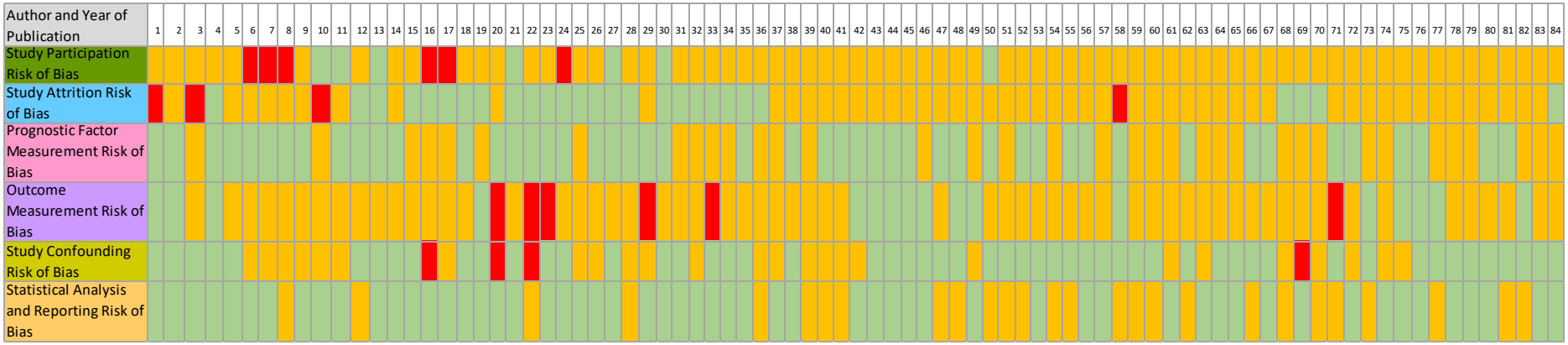
3.4.6.1 Summary

The risk of bias summary is included as a separate item in the supplementary documents (Item 6). The conference abstract (Vernal et al., 2018) of the dataset still being analysed and otherwise not reported was not included in the risk of bias assessment as it was not possible to assess the methodology adequately. Studies were mostly rated as moderate or low risk of bias, with the main sources of bias being unclear reporting around whether the samples included in secondary data analyses were different to the original sample, and insufficient information about the use of measures and analyses procedures. There were also few reports which explicitly specified whether data were missing, and it was hard to identify the impact of refusal to participate on sample size. There seemed to be few identifiable errors in reporting (e.g. scores reported which were greater than the maximum possible score for a specific measure). No major inconsistencies were found between reports of the same dataset, and there was

no individual study at such a high risk of bias as to warrant exclusion from this review.

Table 3.6 gives a summary of risk of bias across all studies that were included in the full review as there was insufficient methodological information to rate conference abstracts on risk of bias. Each section of the tool is then discussed below.

Table 3.6: Risk of Bias Across studies



Colour Key: Red – high risk of bias; Orange – moderate risk of bias; Green – low risk of bias

1. Bargenquast and Schweitzer (2014)
2. Schweitzer et al. (2017)
3. Massé and Lecomte (2015)
4. Lysaker et al. (2018b)
5. Abu-Akel and Bo (2013)
6. Abu-Akel et al. (2015)
7. Bo et al. (2013)
8. Bo et al. (2014)
9. Bo et al. (2015)
10. Austin et al. (2019)
11. Jansen et al. (2017)
12. Trauelsen et al. (2016)
13. Trauelsen et al. (2019)
14. Davies et al. (2017)
15. (Wright et al., 2019a)
16. Bröcker et al. (2017)
17. Rabin et al. (2014)
18. Nicolò et al. (2012)
19. Popolo et al. (2017)
20. de Jong et al. (2016)
21. de Jong et al. (2018c)
22. van Kleef et al. (2015)
23. de Jong et al. (2018a)
24. Mitchell et al. (2012)
25. Reilly (2011)
26. MacBeth et al. (2014)
27. McLeod et al. (2014)
28. Breustedt (2017)
29. Inchausti et al. (2017a)
30. Inchausti et al. (2017b)
31. Tas et al. (2012b)
32. Tas et al. (2014)
33. Aydin et al. (2016)
34. Lysaker et al. (2005)
35. Buck et al. (2012)
36. Davis et al. (2011)
37. de Jong et al. (2014)
38. Fridberg et al. (2010)
39. Luedtke et al. (2012)
40. Lysaker et al. (2007)
41. Lysaker et al. (2008)
42. Lysaker et al. (2010a)
43. Lysaker et al. (2010b)
44. (Lysaker et al., 2011g)
45. Lysaker et al. (2011h)
46. Nabors et al. (2014)
47. Hamm et al. (2012)
48. Buck et al. (2012)
49. Firmin et al. (2017)
50. Kukla et al. (2013)
51. Minor et al. (2015a)
52. Hasson-Ohayon et al. (2018a)
53. James et al. (2016)
54. James et al. (2018)
55. Leonhardt et al. (2015)
56. Luther et al. (2016a)
57. Lysaker et al. (2013c)
58. Lysaker et al. (2015c)
59. Minor and Lysaker (2014)
60. Minor et al. (2015c)
61. Minor et al. (2019)
62. Schnakenberg et al. (2016)
63. Francis et al. (2017)
64. Vohs et al. (2014)
65. Vohs et al. (2015b)
66. Vohs et al. (2015c)
67. Bonfils et al. (2016)
68. Bonfils et al. (2018)
69. Bonfils (2017)
70. Bonfils et al. (2019)
71. Luther et al. (2020)
72. MacBeth et al. (2016)
73. Buck et al. (2014)
74. Lolley (2012)
75. Lysaker et al. (2014d)
76. Lysaker et al. (2014e)
77. Snethen et al. (2014)
78. Vohs et al. (2016)
79. Vohs and Lysaker (2014)
80. Luther et al. (2016b)
81. Gagen et al. (2019)
82. Lysaker et al. (2019)
83. Wright et al. (2020b)
84. Wright et al. (2019b)

3.4.6.2 Study participation

This section explores issues of study population, including representativeness of the sample of interest in reports and the likelihood representativeness can be assured based on recruitment efforts and sampling frames. Most reports (71) were rated moderate overall for this domain with 7 rated low and 6 rated high. The most common issues contributing to these ratings were that reports only inferred the target population they intended to recruit by describing the characteristics of their already-recruited sample. Samples were commonly recruited via convenience sampling and reliability and validity of certain information including diagnosis were not always confirmed. However, many reports included sufficient detail to understand the characteristics of the recruited sample, such as diagnosis, age, and whether participants were inpatients or outpatients and baseline characteristics were given for these.

Most studies gave some indication of how participants were selected based on explicit criteria and confirmed these criteria were met before anyone was enrolled into the study using validated measures. In addition, most studies also had explicit inclusion and exclusion criteria. Most studies did not provide sufficient information on how participants were approached (including the period of recruitment, although location by country was often described). This coincided with many reports being unclear about the way in which their participants were selected for secondary data analysis from a previous sample, and whether the criteria for inclusion between the original sample and the current study were different. Ultimately, this made it difficult to confirm whether there was adequate participation in the study by eligible individuals.

3.4.6.3 Study attrition

Twenty-seven studies were assessed as having low risk of bias, 53 studies as moderate risk of bias and 4 studies as high risk of bias for this section. Most of the studies were of cross-sectional data, however they were still assessed on relevant items including whether proportion of participants providing outcome data was adequate. The factor most often contributing to a moderate rating was that studies were underpowered. Additionally, because of lack of clarity about the sample contributing as secondary data analysis, it often was not clear whether there was loss of data from the original sample or any differences in key characteristics of lost participants. Those studies that had high risk of bias

suffered from attrition (Bargenquast & Schweitzer, 2014), the sample was explicitly not compared for differences between participants lost to attrition or from original analyses (Luther et al., 2016a; Lysaker et al., 2015c), or that characteristics between the sample lost to attrition and those who completed the study were significantly different (Austin et al., 2019). While this may have increased risk of bias for this section of these studies, it did not appear that this was a significant limitation of any of the reports.

3.4.6.4 Prognostic factor measurement

Metacognition was selected as the prognostic factor for risk of bias assessment because it is this factor that is being assessed for its ability to predict negative symptom levels. Forty-eight studies were regarded as low risk of bias, 36 studies were indicated as having moderate risk of bias and no studies were at high risk of bias. Overall, these reports appropriately defined metacognition, the measure selected, and which domains were of interest in that specific report. Many studies reported using blind raters to measure metacognition, although several potential risks of bias were unclear. These individuals were not always blind to study hypotheses or relevant outcomes; and sometimes these were the same individuals who carried out the interview meaning they are not entirely independent and could be subject to observer bias (Hróbjartsson et al., 2013). Not all studies conducted assessment of inter-rater reliability, rather citing previous studies with acceptable psychometric properties. This does place studies at additional risk of bias because inter-rater reliability for that particular study is then not guaranteed. Generally, it was deduced that the method and setting for measurement was the same for all participants. Some reports failed to specify that subscales were omitted from analysis, some studies used a data-dependent approach to categorise metacognition (e.g. splitting the sample by high or low self-reflectivity; Bonfils et al., 2018).

3.4.6.5 Outcome measurement

Negative symptoms were considered to be the outcome measurement in this review as this was the primary outcome of interest. Sixty-one studies were regarded to be of moderate risk of bias in this domain, 17 as low risk of bias and 6 as high risk of bias. Often studies defined negative symptoms and reported the use of associated measures acceptably. Most often when studies received a moderate risk of bias, this was due to a failure to report which PANSS items

were contributing to negative symptoms analysis and outcome assessors being unblinded to study hypotheses or other measures. Many studies applied methodologies which may somewhat offset these risks of bias such as providing researchers with adequate training in each measure, however two studies reported as a high risk of bias did not report making sufficient adjustments (de Jong et al., 2016; van Kleef et al., 2015), particularly as the measure used to derive negative symptom scores formed part of the inclusion criteria for this dataset. Another two studies (Aydin et al., 2016; Luther et al., 2020) were rated at a high risk of bias due to inadequate description of the negative symptoms measure used and clear methods to ensure reliability and validity, with negative symptoms data for the former study only appearing in the analyses section and the latter study using negative symptoms data as part of their inclusion criteria. One other study at high risk of bias found psychometric properties were not acceptable and the measure was poorly described, however this may be expected given this was a pilot study (Inchausti et al., 2017a).

3.4.6.6 Study confounding

Fifty-four studies were found to be at low risk of bias for study confounding, where most additional treatments, demographic differences between participants, and identified moderators or covariates were accounted for. It was assumed in most cases that measurement and setting for the measurement of confounds was consistent across all participants. In the 26 cases where studies were rated as moderate, there was lack of clarity around how missing data had been treated, demographic differences weren't included as covariates in the analysis, and once again there was a lack of blinding to other study outcomes. Four studies were rated at a high risk of bias due to use of data-driven approaches (Bonfils, 2017; Bröcker et al., 2017; de Jong et al., 2016; van Kleef et al., 2015).

3.4.6.7 Statistical analysis and reporting

Fifty-seven studies were reported to have low risk of bias for their statistical analysis and reporting. Generally this was demonstrated by sufficient presentation of the variables used, and description in results sections to identify which type of analyses was undertaken, although these did not always appear to be pre-specified. Generally, these analyses seemed appropriate although the reviewers acknowledge their limited experience with some of the analyses

conducted. Of 27 the studies which received a moderate risk of bias for this section, this was often where model building involved the use of clustering participants by profiles, or categorising a continuous variable. In these cases a more detailed picture of the relationship between specific variables might have been obtained by other analyses that would have treated the variables as continuous. The use of data driven may be appropriate given the exploratory nature of some of the research, however this limits the confidence researchers can have in any conclusions.

3.4.6.8 Additional risks of bias

Additional risk of bias mostly resulted from minimal differences in reporting of the same work. It was anticipated that like other risks of bias identified here, this would relate more to a risk posed to clarity of reporting than integrity of the work. There were some reports which showed changes from the write up of preceding conference abstracts (such as a more specific interest in mastery as opposed to the whole of metacognition; de Jong et al., 2014) which may be related to the way in which research evolves during write up or issues with writing concisely for conferences. Equally some moderating relationships which were non-significant in the publication of conference abstracts and were later shown to be significant in journal article publication (e.g. Minor et al., 2015c), may have been related to completeness of data collection at publication. One report showed a significantly different relationship between negative symptoms and metacognition from the thesis to journal article publication, upon author contact it was identified that this was due to the re-rating of MAS-A transcripts to improve inter-rater reliability (Bonfils et al., 2019). In each of these cases it was deduced that these issues related to risks of clarity in reporting rather than to the integrity of the research itself.

In some instances, measures were also perhaps identified in some records and not others, or inclusion criteria or measures used were specified differently in different publications, however usually these issues resulted from differences in terms of phrase, or research question focus rather than substantial differences across studies. The analyses across reports did not appear to be contradictory and the aims of different reports of the same dataset appeared broadly consistent. It was concluded that no studies or indeed any datasets presented

such a substantial risk of bias that they should not be included in any meta-analyses.

3.5 Discussion

Negative symptoms are often unresponsive to treatment, and the evidence that they can be modified by targeting psychological factors such as metacognition is unclear. This systematic review aimed to summarise the literature addressing the relationship between metacognition and negative symptoms, particularly to understand the strength of relationship between these constructs at a high level (i.e. composite or summary scores) and at the level of sub-constructs/domains (e.g. correlations between specific negative symptoms and specific aspects of metacognitive functioning). Our review demonstrates that a substantial number of studies of metacognition in psychosis have measured negative symptoms, often as a covariate, but not usually as the main focus of research.

Findings were mixed in directionality, effect size, and statistical significance. In the case of direct correlations comparing total negative symptoms and metacognitive domains around half of the reported results were statistically significant. The evidence presented suggests an inverse, but unclear relationship between metacognition and negative symptoms. The only report which demonstrated a positive association between metacognition and negative symptoms was a thesis paper which noted this as a spurious finding (Breustedt, 2017) and additionally the subscale for which this was observed (decentration) has notable measurement issues (Lysaker et al., 2005). In addition, no clear pattern was established through descriptive analysis which identified any sample-size, statistical, or quality specific markers indicating why some results were significant and some were not or why some studies showed stronger associations than others. The analyses where negative symptoms were employed as a covariate were similarly mixed.

A secondary aim of this review was to both describe the existing evidence base and systematically examine the quality of studies. One key finding was that the datasets underpinning this literature appear across a large number of different studies. With 32 unique datasets attributed to all papers reviewed, only twelve papers appear to include unique data which has not been published elsewhere (and these data may have been reported on in other studies outwith the scope of

this review). Given that many of the analyses included the same participants as other studies, these findings cannot be meaningfully compared in traditional meta-analysis. While publication bias is possible in any body of literature, reassuringly the largest proportion of reports (by the research team who originally developed the MAS-A), showed mixed results and reflected similar patterns to other research groups' findings not directly involved in the development of this measure.

Studies were generally of moderate or low risk of bias across all QUIPs domains. Measurement issues were one of the most common sources of bias across studies, suggesting several areas for improvement. These include the need for clear reporting around which subscales are used in studies, blinding of researchers, and calculation of psychometric properties for the use of each measure in each study (including inter-rater reliability calculations). As mentioned in the introduction, the decentration subscale of the MAS-A exhibits psychometric problems (Lysaker et al., 2005) which make statistical interpretation more difficult. This may be why several studies (Abu-Akel et al., 2015; Francis et al., 2017; Lysaker et al., 2010a; Massé & Lecomte, 2015; Vohs et al., 2015c) removed decentration in their analyses however this was not always clearly reported. Additionally, it is unclear whether this scale was also removed from the total metacognition score impacting the ability to compare results across studies.

Indeed, these issues, alongside a lack of systematic comparison between negative symptoms and all metacognitive domains across studies, may have contributed to the lack of a clear pattern of relationships being observed. Furthermore, the range of mean scores (Tables 3.1 and 3.2) reported for both negative symptoms and metacognition are skewed towards low to median possible scores on each of these scales. One interpretation of this pattern is that the samples obtained were biased toward individuals with less severe negative symptoms or metacognitive difficulties. Without inclusion of people with more severe negative symptoms and greater difficulties with metacognition it is possible that there was insufficient variance in many studies to detect the full range of effects. This will especially be a problem if there is a non-linear relationship between metacognition and negative symptoms.

Of the relationships between negative symptoms and all metacognition subdomains, 46% were significant. Interestingly, of the few studies investigating subtypes of negative symptoms, differential relationships with metacognitive domains were identified. For example, one study (Tas et al., 2012b) found that Understanding Others' Minds and Decentration were related to perceived effort, an experiential negative symptom construct, but not Self-reflectivity or Mastery. In comparison, both these latter constructs were significantly related to expressive negative symptoms in another study (Austin et al., 2019). This calls into question whether the tendency to treat negative symptoms as monolithic might obscure any relationship between these symptoms and metacognitive subtypes. However, while we see some signals of potential interesting relationship between these constructs, we are also not able to rule out the possibility that no true relationship between metacognition and negative symptoms exists, as quantified using these measures or that the associations observed were random and due to chance. Further fine-grained analyses of negative symptoms and domains of metacognition is warranted provided there is also an awareness of any impact this would have on the requirements for studies to achieve adequate statistical power.

Several studies using cluster analyses or conversion of continuous variables into categories did not find that negative symptoms increased linearly across groups of decreasing metacognitive ability (e.g. Lysaker et al., 2007; Vohs & Lysaker, 2014). This may reflect a true non-linear relationship between these constructs, or alternatively it is possible that the combination of several metacognitive components in these clusters obscured relationships being driven by specific components alone. Additionally, some of the difference in negative symptom scores across metacognitive clusters were minimal (Vohs & Lysaker, 2014) and it is unclear whether the loss of information through clustering (Franke et al., 2009) might have contributed to this. Given that clustering requires validation and can be impacted by insufficient power (Clatworthy et al., 2005), it is unclear whether clustering approaches have contributed to the inconsistency of results and this adds to the difficulty in drawing comparisons across studies investigating the relationship between metacognition and negative symptoms. Furthermore, given that we understand metacognition and negative symptoms to be rather complex constructs likely to be influenced by other factors, cross-

sectional research is not optimal for establishing the likely strength and direction of these relationships.

3.5.1 Strengths and limitations

One strength of this review is the use of broad search and screening criteria to identify studies where negative symptoms were measured but not a focus of a study. The reduction of reports from 4061 to the final 85 records reviewed perhaps indicates that the search was initially relatively broad. This seems to have benefitted this review in that almost half of the papers identified did not explicitly focus on negative symptoms but did report relevant data and may have otherwise been unidentified. However, it is likely that since the completion of this review more studies have been published which would be eligible for inclusion. Several co-authors had input in the screening, data extraction and risk of bias and all elements of these methods had a high rate of agreement. The collaboration with authors of included studies was of a very high rate and led to fundamental characteristics of the reports being identified which would not have been possible otherwise. The inclusion of conference abstracts and theses as well as journal articles was comprehensive and helped identify risk of bias but given the iterative nature of these works which are often developmental it is possible that their inclusion has not added material benefit to the body of literature.

The review is also limited in certain ways. Only a proportion of screening and data extraction was independently completed by a separate reviewer. As indicated, there are significant limitations to the generalisability of these findings due to methodological heterogeneity across studies. Exact determination of the unique number of participants was not possible due to sample overlap across publications, and traditional meta-analyses would have been difficult to achieve given the range of statistical relationships reported and heterogeneity in items contributing to analyses. This means no summary estimate of effect is available. Risk of bias around reporting of these studies may also limit the confidence with which researchers can be certain about any findings.

3.6 Conclusion

This review has identified a gap in understanding of the relationship between metacognition and negative symptoms, and has comprehensively analysed the available evidence base. The high heterogeneity in the literature was attributed to methodological differences in the use of negative symptom and metacognition measures and lack of clarity in reporting around overlapping participants in datasets. This obscures whether the lack of consistency in relationships between negative symptoms and metacognition are due to measurement error, sampling bias (either in the variables selected or range of participants included) or both. Nonetheless, a consistent inverse relationship between negative symptoms and metacognition was observed. Given also, that negative symptoms often had a significant impact on the relationship between metacognition and other conceptually relevant constructs, such as empathy, functioning and self-esteem, it is important to conduct further research examining these constructs. The findings also raise questions around whether homogenising negative symptoms and metacognition may obscure potential significant relationships between individual negative symptoms and metacognitive subtypes. This makes a strong case for future research which investigates negative symptoms and metacognition at the item level, and ultimately, research designed specifically to investigate the relationship between metacognition and negative symptoms.

Chapter 4: The relationship between negative symptoms and metacognition - An Individual Participant Data Meta-Analysis

4.1 Abstract

Background: Negative symptoms are a persistent, yet under-explored problem in psychosis. Disturbances in metacognition are potentially associated with negative symptom development and maintenance. This meta-analysis uses Individual Participant Data (IPD) from existing research, which could not otherwise be statistically compared, to compare associations between summed and domain-specific scores of negative symptoms and metacognition.

Methods: Datasets containing individuals with negative symptom and metacognition data, aged 16+ with psychosis were identified according to pre-specified parameters. IPD integrity and completeness were checked and data were synthesised in two-stage meta-analyses of each negative symptoms cluster compared with metacognition in seemingly unrelated regression using restricted maximum likelihood estimation. Planned and exploratory sensitivity analyses were also conducted.

Results: Thirty-three eligible datasets were identified with 21 bearing sufficient similarity and availability to be included in meta-analyses, corresponding to 1270 participants. The strongest significant relationships observed were between summed scores of negative symptoms and total metacognition (ß= -0.114 – to -0.688), individual negative symptoms relationships were weaker (ß= -0.029 – to -0.101). The original PANSS negative subscale (PANSS-ONS), expressive negative symptoms and lack of spontaneity were related to self-reflectivity (ß= -0.281, -0.032 & -0.007 respectively) and PANSS-ONS was related to understanding others' minds (ß= -0.410). These domain-specific findings were not significant when controlling for covariates. Sensitivity analyses did not identify any confounds.

Discussion: This robust meta-analysis finds summed scores of metacognition and negative symptoms are more strongly related than any of their subcomponents, although measurement variability may impact confidence in these findings. Research differentiating negative symptom profiles and continued granular

exploration of the relationship between metacognition and negative symptoms is required.

4.2 Background

The previous review indicates that there may be a relationship between negative symptoms and metacognition, however the current literature has not systematically assessed this in existing statistical analysis. As highlighted by previous research, viewing negative symptoms as an undifferentiated group of experiences has undermined treatment progress (Kaiser et al., 2017). Given that negative symptoms are recognised as a persistent clinical problem for people experiencing psychosis (Sauve et al., 2019) and more research examining specific mechanisms involved in their development and maintenance is welcomed (Marder & Galderisi, 2017), the level of granularity required in assessing these relationships needs to be clarified. As there is already substantial existing data examining these constructs, analyses of existing data may be both economical and less resource intensive than new primary data collection, as well as offering the ability to correct for measurement and sample artefacts in individual samples (Schmidt, 1992).

However, there are several factors that limit the potential effectiveness of a traditional meta-analyses of existing metacognition and negative symptom literature. The systematic review findings (see Chapter 2) were mixed, with poorer overall metacognition and disturbances in sub-domains of metacognition (self-reflectivity, understanding others' minds, decentration and mastery) being linked to higher levels of negative symptoms in some studies, and not others. Based on current evidence, impaired overall metacognitive functioning is the most consistent correlate of negative symptoms in the metacognition literature (compared to individual metacognitive domains; see chapter 2). No single sub-domain of metacognitive functioning is associated with negative symptoms (treated as a summed score) across studies.

Complicating this, at least 86% of the reports in the systematic review (chapter 2) mentioned data already published elsewhere, and their analyses treat metacognition and negative symptoms as summed scores as opposed to investigating their components. Additionally, participants are often grouped based on composite scores across several metacognitive and symptom domains

(such as total schizophrenia symptoms and metacognition levels; e.g. Firmin et al., 2017; Lysaker et al., 2019). Hence, isolating the impact of metacognition on negative symptoms independent of these profiles or study design choices cannot be determined with confidence from current published papers alone. Further analyses are therefore required to determine specificity of metacognitive associations with negative symptoms and whether certain domains of metacognition serve as better targets for intervention, and whether this is the case for specific or all negative symptoms.

Individual Participant Data Meta-Analysis (IPDMA) has been historically recognised to overcome many of these sampling and study design issues (Cooper & Patall, 2009). Much in the way that meta-analyses can correct for artefacts across primary data collection, IPDMA can perhaps better correct for study level artefacts (i.e. the ecological fallacy) across publications compared with a traditional meta-analysis (Debray et al., 2015). Indeed, the quantity of existing data examining relationships between metacognition and negative symptoms means these constructs can be explored effectively. However, given the level of participant overlap between studies and that several studies do not analyse associations between negative symptoms and metacognition (Chapter 3), IPDMA would give a better estimate of the relationship between these variables and would allow comparisons which would not be possible when compared with a traditional meta-analysis (Riley et al., 2010a).

IPDMA can be conducted in a one- or two- stage approach (either synthesising all data in a single hierarchical multivariate model or calculating the effect size of interest for each study and synthesising these as in traditional meta-analysis, respectively; see Burke et al. (2017) for more details). Largely it appears that both produce relatively similar results (Debray et al., 2015). Furthermore, many of the factors that can lead to bias in two-stage approaches (rare events and extremely small sample sizes, see Burke et al. (2017)) are not especially prevalent factors identified in the preceding systematic review of the relationship between negative symptoms and metacognition.

4.2.1 Study aims and research questions

For the reasons outlined above, study 2 is a two-stage IPDMA of studies assessing the relationship between negative symptoms and metacognition in people who

experience psychosis, when treated as summed or domain-specific scores. This aimed to build upon the characterisation of the literature in the preceding systematic review by systematically exploring the statistical relationships between these constructs. The focus of the analyses was to investigate whether subcomponents of metacognition had different relationships with individual negative symptoms. Given that previous research identifies subscales of metacognition as highly correlated with each other, a multivariate meta-analyses will be used to jointly synthesise these constructs and account for their likely shared variance (Burke et al., 2017). This allows a robust assessment of the ways in which negative symptoms and metacognition are related. Differences between these results and aggregated data reported in chapter 3 were explored to determine whether any specific study and participant level factors are likely to affect any observed relationships between metacognition and negative symptoms. Given the lack of analyses exploring a relationship between domains of metacognition and individual negative symptoms or clusters, no predictions were made around which metacognitive domains would be more or less strongly associated with negative symptom clusters or individual symptoms.

Research questions

1. Using IPD, what are the relationships between different components of metacognition and specific negative symptoms for individuals previously included in studies investigating these variables?

2. Given relationships demonstrated by IPD, what participant and study level specific factors may be responsible for the variance in results across studies?

3. How do data analyses of individual participant level data exploring metacognition and negative symptoms compare with those analyses of previously aggregated and potentially overlapping datasets in terms of ability to draw conclusions, and risk of bias?

Hypotheses

1.1. Primary Analysis: Levels of metacognitive abilities will be predictive of levels of specific negative symptoms. However, given limited existing published evidence, no predictions are made regarding which specific metacognitive

abilities are predictive of which specific negative symptoms. It is predicted that significant relationships will be inversely (negatively) correlated i.e. as a component of metacognition increases, a specific negative symptom will decrease. Sample characteristics for participants included in these analyses will also be examined and statistically controlled where possible.

1.2. The null hypothesis is that there will be no evidence demonstrating predictive relationships between any metacognitive capacities and any specific negative symptoms.

2.1. It is also predicted that inclusion of covariates will explain additional variance in the statistically significant models from the primary analysis, although no predictions are made about which covariates may be explanatory.

2.2. The null hypothesis is that there will be no evidence indicating that the covariates identified explain any of the variance in these models.

3.1. It is not anticipated that the results from aggregate reports will be comparable to those of IPDMA. It is predicted that the IPDMA will confer significant advantages over aggregate data analysis. No predictions are made as to whether there will be inconsistencies between IPD data and aggregate data, or between studies which did and did not provide IPD.

3.2. The null hypothesis is that there will be no evidence of any differences between IPD and aggregate data analyses.

4.3 Methods

4.3.1 Protocol and registration

Methods were developed according to a protocol (available on PROSPERO, registration number: CRD42019130678). The design followed guidelines outlined in the Cochrane Handbook for systematic reviews (Higgins & Green, 2011) and the Preferred Reporting Items for Systematic review and Meta-Analysis Protocols (PRISMA-P; Moher et al., 2015). The protocol describes both the systematic review and IPDMA methods. The methods and criteria shown here are pertinent to the IPDMA only. The methods and findings outlined here are reported in accordance with Preferred Reporting Items for Systematic Review and Meta-

Analysis (PRISMA; Moher et al., 2009) guidelines and PRISMA guidelines for IPD (PRISMA-IPD; Stewart et al., 2015). Any deviations from the protocol are described, and where recommendations from current guidelines are not followed, appropriate rationale is provided.

4.3.2 Eligibility criteria and information sources

Datasets were eligible if they contained adult participants (defined as aged 16+) who experienced psychosis and reported both negative symptoms and metacognition using reliable and valid measures (as per-protocol definition of each construct). Datasets identified in Chapter 3 were considered eligible for inclusion in the meta-analysis. Any datasets which were identified as not eligible for systematic review inclusion (i.e. papers published in different languages, unpublished work) were also considered eligible for inclusion if they contained the pre-requisite data. No datasets created after the conclusion of the systematic searching conducted for the systematic review (30th April 2019) were included in the IPDMA. Further details on search procedures and study selection process can be found in Chapter 3 and the relevant appendices.

4.3.3 Data items

Datasets were included if they contained any reliable and valid measures meeting per-protocol definition of negative symptoms and metacognition, provided there were sufficient studies (2+) to conduct meta-analysis. The main measures identified in the meta-analysis included the Metacognition Assessment Scale – Adapted (the MAS-A; Semerari et al., 2003; Lysaker et al., 2005) subscales and Positive and Negative Symptoms Scale (PANSS; Kay et al., 1987) negative symptoms subscale data. The MAS-A rates narrative responses in terms of increasingly complex reflections across four metacognitive domains: Self-Reflectivity (the ability to make sense of self-referential information), Understanding Others' Minds (the ability to understand the minds of others), Decentration (the ability to make sense of experiences independent to the self) and Mastery (the ability to respond to psychological problems). The MAS-Revised (MAS-R; Carcione et al., 2010a) and the Metacognition Assessment Interview (MAI; Semerari et al., 2012) were also identified in the systematic review and use an integrative model of metacognition also.

The Positive And Negative Syndrome Scale (PANSS) was the most used measure of negative symptoms in the systematic review, although variations of the Brief Psychiatric Rating Scale were also identified. Through factor analysis, the PANSS (measuring symptoms of psychosis) has been categorised into subdomains. It is contested as to whether some items on the original negative symptom subscale (PANSS-ONS) are better conceptualised as other symptom types, such as disorganisation. There is little consensus on which factor structure of the PANSS gives the most accurate representation of distinct symptom clusters (Wallwork et al., 2012), therefore we (non-systematically) compiled data for all PANSS items which have been included under the negative symptoms subscale in any factor analyses. These factor analyses and the corresponding items are listed in Table 4.1.

Table 4.1: Negative symptom items identified by confirmatory factor analysis

	NEGATIVE SYMPTOM ITEMS															
CONFIRMATORY FACTOR ANALYSIS STUDY	**N**							**G**								**P**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**5**	**7**	**8**	**11**	**13**	**14**	**15**	**16**	**2***
Kay et al. (1987)	X	X	X	X	X	X	X									
Kay and Sevy (1990)	X	X	X	X		X		X	X		X	X			X	
Bell et al. (1994)	X	X	X	X		X			X			X		X		
White et al. (1997)	X	X	X	X		X		X	X	X		X	X			
Marder et al. (1997)	X	X	X	X		X			X						X	
van der Gaag et al. (2006)	X	X	X	X		X			X	X		X			X	X
Citrome et al. (2011)	X	X	X	X		X			X						X	
Wallwork et al. (2012)	X	X	X	X		X			X							
Reininghaus et al. (2013)	X	X	X	X		X			X			X			X	
Kelley et al. (2013)	X	X	X	X		X			X			X			X	X
Total (out of 9)	9	9	9	9		9		2	9	2	1	6	1	1	6	2

Code	Negative symptom item
N1	Blunted affect
N2	Emotional withdrawal
N3	Poor rapport
N4	Passive/apathetic social withdrawal
N5	Difficulty in abstract thinking
N6	Lack of spontaneity and flow of conversation
N7	Stereotyped thinking
G5	Mannerisms and posturing
G7	Motor retardation
G8	Uncooperativeness
G11	Poor attention
G13	Disturbance of volition
G14	Poor impulse control
G15	Preoccupation
G16	Active social avoidance
P2(-)	Conceptual disorganisation

*** This item is not analysed individually as found by van der Gaag et al. (2006) to be negatively correlated with negative symptom items.**

We also pre-specified interest in the following demographic and secondary outcome data:

Demographics

- Age
- Education
- Gender
- Adverse childhood experiences
- Socioeconomic status

Secondary outcomes

- Neurocognition (e.g. measures of attention/memory/executive functioning)
- Discrete metacognitive abilities (Including measures of theory of mind/mentalisation or attributional biases)
- Functioning (including overall/social/domestic and personal role functioning)
- Wellbeing (including quality of life/satisfaction measures)
- Social support (based on individual perceptions or objective levels of support)

Demographic variables were sourced for all included datasets (including age, gender and education), and we created one variable (whether participants experienced first or multiple episode psychosis) from study reports and author contact where this information was not reported. For longitudinal data with repeated measures, only the first epoch data were selected. Of the reports where IPD was not obtained, there were no comparable published analyses

which could contribute to the IPDMA based on findings from the systematic review.

4.3.4 IPD data handling and integrity checking

Authors were contacted with a pre-defined author request form (Appendix 6) outlining the criteria for data items requested. Only anonymised data were requested, and only one governance request was made from contacted authors around the timeline for data to be processed, which was upheld. Data were extracted to Excel and processed according to the Data Protection Impact Assessment to ensure risks in processing were minimised and data were processed in line with governance requirements (DPIA; Appendix 7). Data were handled in accordance with agreements with co-authors providing original data in line with relevant university policies (including University of Glasgow Good Management of Research Data policy). It was also confirmed that no further ethical approvals were required for this study (Appendix 8). Data integrity was reviewed by the primary reviewer checking for consistency (i.e. ensuring scores reported were within the possible score range for each measure) and completeness. Invalid items and missing cells were recorded as per guidelines (Tierney et al., 2015). Any invalid items (total scores not within the possible total score range) were re-calculated where IPD permitted this. Reviewers and original authors discussed reasons for missing data and made judgements regarding whether data were likely to be missing at random or associated with dropout or other factors.

4.3.5 Data synthesis methods

As per protocol it was assessed whether there was sufficient data to conduct meta-analyses. There was sufficient PANSS and MAS-A data, however only three, two and two datasets, respectively, contributed to BRPS, MAS-R MAI data. Given that the combined sample size for each were less than 100, it was decided that these measures had insufficient data to carry out any meta-analyses, and total symptom scores were not similar enough to combine with existing measures. Secondary outcomes identified (such as functioning data and neurocognitive variables) plus some demographic information (socioeconomic status and adverse childhood experiences) were not recorded consistently enough to be meaningfully combined and included in meta-analysis. Some data items

(including race and geographical location) were not requested or assessed as they were multi-categorical variables and would add substantial computational complexity to the model). Age, gender, and education were consistently recorded and therefore included as covariates in statistically significant models. Data were assessed according to protocol parameters for variable transformation (to categorical or continuous depending on whether this would increase eligible data for analyses) however no additional benefits of transformation were identified. Included data was relatively complete (approximately 86% across all samples), therefore no imputation of missing data was conducted.

Meta-analyses were conducted in a two-stage approach using R version 3.6.1 (code available at https://osf.io/ub3aj/) and according to the statistical analysis plan (Appendix 9). To deal with the computational complexity of the meta-analytic models used, individual meta-analyses were conducted for each of the 16 specific negative symptoms identified in Table 4.1 to estimate the predictive value of each subcomponent of the MAS-A (self-reflectivity; understanding others' minds; decentration; and mastery). Seemingly Unrelated Regression (SUR) was used to account for the correlation between these different metacognitive capacities (Zellner, 1962), as previous analysis shows these subcomponents are highly correlated (Bonfils et al., 2016). The four beta coefficients obtained from each SUR analysis (describing the degree of change in a specific negative symptom given a 1-unit change in each metacognitive domain) are the summary measures of interest. These were combined in a multivariate meta-analyses which again attempted to control for the relationship between metacognitive domains, unlike a univariate approach. A random-effects model was used and was estimated using REstricted Maximum Likelihood (REML), to reduce downward bias in between-study variance estimates (Burke et al., 2017).

We conducted several planned sensitivity analyses at each stage, including checking assumptions for regression analyses, comparison between SUR outcomes and those which would be observed by multiple regression, and a comparison of univariate versus multivariate meta-analyses. Additionally, IPD for individual negative symptoms were not available in all cases, but across several datasets summed symptom scores were available. These were examined *post hoc* using the original version of the subscale (PANSS-ONS) and the Bell et al. (1994) and van der Gaag et al. (2006) negative symptom factor structures (PANSS-BNS,

and PANSS-VDGNS) as each are commonly used in research but include different items. This allowed examination of the possibility that one summed score was more strongly associated with metacognition than another. As it is also recognised that negative symptoms can be separated into experiential and expressive negative symptoms, and these clusters have been derived from PANSS items, these were therefore also compared using the Harvey et al. (2017) factor structure which aligns with these conceptualisations. Similarly, the total metacognition score was compared to explore whether this was more strongly associated with negative symptoms than individual metacognitive domains.

Post hoc, the Bell et al. (1994) cognitive subscale, and the van der Gaag et al. (2006) disorganisation subscale (BELLCOG and VDGCOG respectively, which both measure cognitive disorganisation) were examined to establish whether disorganisation items accounted for some findings. As a large proportion of the studies included multiple episode psychosis (MEP) groups, the inclusion of MEP populations alone was also compared to the original results. We investigated the impact of the configuration of the data on the results by investigating the differences in results when data was clustered by levels of metacognition and negative symptoms, and where data was scaled to standardise unit differences across scales (using both min-max normalisation and z-score standardisation). We also re-analysed findings which were significant in the primary analyses with inclusion of age, gender, and education as covariates, as these data were also commonly available across studies.

A formal risk of bias assessment undertaken for the purposes of the systematic review revealed no study-specific factors which led to up- or down- weighting of any study in meta-analyses. For all meta-analyses, between-study heterogeneity was quantified by the I^2 statistic and observed using forest plots (in the case of meta-analyses exploring metacognitive subdomains, forest plots were derived from the univariate analyses due to these being unavailable in the package for multivariate models). We used two-sided *p* values and 95% Confidence Intervals (CIs) of the estimated effect to determine the statistical significance of results and small study effects were assessed using funnel plots and influence of outliers was checked through visual inspection and influence diagnostic computations (Viechtbauer & Cheung, 2010). For any meta-analyses with significant results, subsequent tests were performed to determine whether age, gender and education affected the results.

4.4 Results

4.4.1 Data availability

The 33 eligible datasets identified are described in Tables 4.2 and 4.3. This includes all datasets included in the systematic review and an additional dataset identified in review procedures but not included in the systematic review because it was not reported in English. Of these, twelve datasets were not included in meta-analyses as detailed in Figure 4.1 (adapted from PRISMA-IPD guidelines, Stewart et al., 2015). Broadly, an estimated 276 individuals' data were excluded because of use of different measures (e.g. the Metacognitive Assessment Interview (MAI), the MAS Revised (MAS-R) and the Brief Psychiatric Rating Scale (BPRS)) which prevented the data being compared meaningfully in meta-analyses, and an estimated 152 individuals' data were not included because data were unavailable. One sample (Kukla et al., 2013), where participants were estimated to overlap substantially with other USA datasets, was not independently included in analyses; however, the estimated unique participants (less than 5% of the sample i.e. 4 participants) was relatively low. Thirty-two participants were excluded from another sample (MacBeth et al., 2014), as their data were only available as MAS-R ratings. A summary of the contributing datasets is given in Tables 4.2 and 4.3.

The final number of unique participants contributing to analyses was 1270. The unique individual participant data was greater than the 1241 participants estimated based on the sum of the samples included in published reports. Figure 4.2 shows that raw IPD mostly matched published reports. Where IPD was greater this may be due to published analyses only including participants with available data for variables of interest in that specific study. In cases where the IPD obtained was lower than the expected sample size based on publication, this was due to overlapping subsamples where the other participants are accounted for elsewhere. One dataset (Bonfils et al., 2016) had much greater IPD than the aggregate data estimate. These additional participants were only reported in publications which included data from other overlapping samples (e.g. Gagen et al., 2019), which explains why it was not attributed to the correct dataset (Bonfils et al., 2016) when estimating the aggregate data sample size. In this sense the overall IPD obtained was estimated to represent 87.14% of the published data (derived from the available data as a proportion of that which

could be meaningfully synthesised from the eligible datasets), which is in line with recommended guidelines (Tierney et al., 2015), but contains more participants than the published data.

Table 4.2: Summary of datasets identified from systematic search

Name of database	Studies included	Description of research reported in database	Negative symptoms and metacognition measures reported
1 Australia sample (Sample Size Range (SSR): 8-11)	1. Bargenquast and Schweitzer (2014) 2. Schweitzer et al. (2017)	Investigated use of metacognitive narrative psychotherapy for people with schizophrenia.	Negative Symptoms (NS): Brief Psychiatric Rating Scale (BPRS) – Extended version Metacognition: Metacognition Assessment Scale – Adapted (MAS-A) subscales and total scores
2 Canada sample (SSR: 50)	1. Massé and Lecomte (2015)*	Reports distinct metacognitive profiles across individuals with First Episode Psychosis (FEP) who had previously received group Cognitive Behavioural Therapy (CBT), and their relationship with social functioning and perceived social support.	NS: BPRS – Extended version Metacognition: MAS-A – subscales and total score (excluding decentration)
3 Chile sample (SSR: 26)	1. Lysaker et al. (2018b)	Compares metacognition across persons with schizophrenia, bipolar disorder and community controls to replicate findings from USA datasets. Interested in relationship between metacognition and negative and cognitive symptoms.	NS: PANSS (Factor Structure (FS): Bell et al., 1994) Metacognition: MAS-A subscales and total score - Spanish translation
4 Denmark sample 1 (SSR 42-108)	1. Abu-Akel and Bo (2013) 2. Abu-Akel et al. (2015) 3. Bo et al. (2013) 4. Bo et al. (2014) 5. Bo et al. (2015)	Investigates relationship between psychopathy and metacognition across men and women, and groups who do and do not have a forensic history. Some studies also investigate aggression and Bo et al. (2015) interested in whether blunted affect and emotional withdrawal related to metacognitive deficits.	NS: PANSS - individual item analyses or abbreviated version Metacognition: MAS-A - subscales and total score, uses the Hare Psychopathy Checklist – Revised to generate ratings.
5 Denmark sample 2 (SSR: 28-101)	1. Austin et al. (2019)* 2. Jansen et al. (2017) 3. Trauelsen et al. (2016)* 4. Trauelsen et al. (2019)	Investigates relationship between childhood trauma and positive and negative symptoms of people with FEP already participating in a larger study investigating the efficacy of early intervention services, and their relationship to metacognition. Carer outcomes also assessed (Jansen et al., 2017) and prediction of negative symptoms longitudinally (Austin et al., 2019).	NS: PANSS (FS: Bell et al., 1994; van der Gaag et al., 2006; Harvey et al., 2017, plus individual items) Metacognition: MAS-A –subscales and total score
6 Denmark sample 3 (SSR: 64)	1. Vernal et al. (2018)	Investigates relationship between symptoms of schizophrenia and variables including metacognition in individuals receiving early intervention services.	NS: PANSS Metacognition: MAS-A
7 England sample 1 (SSR: 26-80)	1. Davies et al. (2017) 2. Wright et al. (2019a)* 3. Wright et al. (2019b)*	Investigates relationship between metacognition and neurocognition, functional capacity and social occupational functioning (Davies et al., 2017; Wright et al., 2019a) and	NS: PANSS (FS: Kay et al., 1987) M: Metacognition Assessment Interview (MAI) subscales and total score

		metacognition and self-defining memories (Wright et al., 2019b) in people with FEP.	
8 England 2 sample (SSR: 26 – note minus 26 participants confirmed to be from England sample 1)	1. Wright et al. (2020b)	Investigates whether metacognition, intellectual aptitude and functioning were predictive of work outcomes for individuals experiencing FEP.	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAI total score
9 Germany sample (SSR: 22)	1. Bröcker et al. (2017)	Validation study of German translation of the MAS-A, comparing with discriminant measures of metacognition for individuals with schizophrenia spectrum disorders.	NS: PANSS (FS: van der Gaag et al., 2006) Metacognition: MAS-A subscales and total score - German translation, ratings generated from a modified semi-structured interview, observing the principles of Operationalised Psychodynamic Diagnosis.
10 Israel sample (SSR: 39)	1. Rabin et al. (2014)	Investigates relationship between metacognition and social quality of life, and link between these variables and positive and negative symptoms in people with schizophrenia and a non-clinical sample with schizotypy traits.	NS: PANSS (FS: Kay et al., 1987) Metacognition: MAS-A - Self-Reflectivity and Understanding Others' Mind subscales
11 Italy sample (SSR: 26-45)	1. Nicolò et al. (2012) 2. Popolo et al. (2017)	Investigates relationship between metacognition and measures of neurocognition and positive, negative and depressive symptoms in people with schizophrenia. Popolo et al. (2017) additionally compares participants to bipolar disorder and control groups.	NS: PANSS (individual items), and the BPRS. Metacognition: MAS-A - subscales and the total score, Nicolò et al. (2012) translated interview into Italian and excludes decentration.
12 Netherlands sample 1 (SSR: 12)	1. de Jong et al. (2016)	Investigates feasibility of Metacognitive Reflection and Insight Therapy (MERIT) for people with schizophrenia with symptoms as a secondary outcome	NS: PANSS (FS: van der Gaag et al., 2006) Metacognition: MAS-A subscales and total score
13 Netherlands sample 2 (SSR: 70)	1. de Jong et al. (2018c) 2. van Kleef et al. (2015)	Investigates the effect of MERIT for people with schizophrenia, with symptoms as a secondary outcome. van Kleef et al. (2015) investigates the mediating role of metacognition on cognitive and social functioning, controlling for symptoms.	NS: PANSS (FS: van der Gaag et al., 2006) Metacognition: MAS-A subscales and total score
14 Netherlands sample 3 (SSR: 50)	1. de Jong et al. (2018a)	Investigates relationship between social cognition, metacognition and history of violence in people with schizophrenia.	NS: PANSS (FS: van der Gaag et al., 2006) Metacognition: MAS-A total score

15 Scotland sample 1 (SSR: 11-29)	1. Mitchell et al. (2012) 2. Reilly (2011)	Investigates variation in levels of metacognition based on history of interpersonal violence in people with experiences of psychosis (Mitchell et al., 2012) and compares this group to a borderline personality disorder population on metacognition, attachment measures and interpersonal difficulties (Reilly, 2011).	NS: PANSS (FS: Kay et al., 1987) Metacognition: Metacognition Assessment Scale – Revised (MAS-R) subscales and total score
16 Scotland sample 2 (SSR: 34)	1. MacBeth et al. (2014)	Investigates relationship between metacognition, symptoms (particularly negative symptoms) and pre-morbid functioning in a FEP sample.	NS: PANSS (FS: van der Gaag et al., 2006) Metacognition: MAS-R subscales and total score - ratings generated from Adult Attachment Interview (AAI) transcripts
17 Scotland sample 3 (SSR: 45)	1. McLeod et al. (2014)*	Investigates whether metacognition is associated with positive and negative symptoms over 12 months in people with FEP, controlling for baseline symptoms, gender, duration of untreated psychosis, and pre-morbid adjustment.	NS: PANSS (FS: van der Gaag et al., 2006) Metacognition: MAS-A subscales - ratings generated from AAI transcripts
18 Scotland sample 4 (SSR: 12)	1. Breustedt (2017)	Investigates feasibility of measuring, and the associations between, autobiographical memory, metacognition, and executive functioning in individuals experiencing acute psychosis.	NS: PANSS (FS: Kay et al., 1987) Metacognition: MAS-A subscales and total score
19 Spain sample 1 (SSR: 12)	1. Inchausti et al. (2017a)	Investigates feasibility of a group-based metacognitive-oriented social skills training intervention for people with schizophrenia.	NS: PANSS - Spanish translation (FS: Kay et al., 1987) Metacognition: MAS-A subscales and total score - obtained via Metacognition Assessment Interview (Spanish adaptation)
20 Spain sample 2 (SSR: 69)	1. Inchausti et al. (2017b)	Investigates effectiveness of a group-based metacognitive-oriented social skills training intervention for people with schizophrenia in comparison to other social skills training.	NS: PANSS - Spanish translation (FS: Kay et al., 1987) Metacognition: MAS-A subscales and total score - obtained via MAI (Spanish adaptation)
21 Turkey sample 1 (SSR: 30)	1. Tas et al. (2012b)*	Investigates relationship between metacognition and intrinsic motivation and learning potential in people with schizophrenia.	NS: PANSS (FS: Kay et al., 1987) Metacognition: MAS-A subscales - obtained via Indiana Psychiatric Illness Interview (IPII) interviews (Turkish translation)

22 Turkey sample 2 (SSR: 30)	1. Tas et al. (2014)	Investigates differences between people with schizophrenia and people with bipolar disorder on these intrinsic motivation and metacognition, controlling for neurocognition.	NS: PANSS (FS: Kay et al., 1987) Metacognition: MAS-A subscales - obtained via IPII interviews (Turkish translation)
23 Turkey sample 2 (SSR: 35)	1. Aydin et al. (2016)	Investigates associations between attachment, trauma and metacognition in people with schizophrenia.	NS: PANSS (FS: Kay et al., 1987) M: MAS-A - obtained from IPII (Turkish translation)
24 USA sample 1 (SSR: 61)	1. Lysaker et al. (2005)	Investigates relationship between metacognition, neurocognition, positive, negative and disorganised symptoms and awareness of illness in people with schizophrenia already participating in a Randomised Controlled Trial (RCT) investigating the effectiveness of CBT on work outcomes.	NS: PANSS individual items Metacognition: MAS-A subscales and total score (excluding decentration) – older version of IPII
25 USA sample 2 (SSR: 36 – 102)	1. Lysaker et al. (2012)* 2. Davis et al. (2011) 3. de Jong et al. (2014) 4. Fridberg et al. (2010) 5. Luedtke et al. (2012) 6. Lysaker et al. (2007) 7. Lysaker et al. (2008) 8. Lysaker et al. (2010a) 9. Lysaker et al. (2010b) 10. (Lysaker et al., 2011g)* 11. Lysaker et al. (2011h) 12. Nabors et al. (2014)	Investigates relationships between metacognition and it's various subscales with variables such as jumping to conclusions (Lysaker et al., 2012), therapeutic alliance (Davis et al., 2011), job satisfaction (de Jong et al., 2014), executive functioning (Fridberg et al., 2010; Lysaker et al., 2008), affect recognition and self-appraisal (Luedtke et al., 2012), social cognition or function (Lysaker et al., 2010a; 2010b; 2011h), emotional distress and sexual abuse (Lysaker et al., 2011g), and stigma (Nabors et al., 2014) in people with schizophrenia, and in some cases controlling for variables such as symptoms and neurocognition. Participants were previously studied in comparison of CBT and social supportive therapy.	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAS-A - subscales and total score, Fridberg et al. (2010) added two extra questions to the IPII to give participants an additional opportunity to present decentration.
26 USA sample 3 (SSR: 49 – 115)	1. Hamm et al. (2012) 2. Leonhardt et al. (2014) 3. Lysaker (2011) 4. Lysaker et al. (2011b) 5. Lysaker et al. (2011j) 6. Lysaker et al. (2012)	Investigates relationship between metacognition and its various subscales with variables such as symptoms and affect (Hamm et al., 2012); discreet metacognitive capacities (Leonhardt et al., 2014; Lysaker et al., 2011b); insight (Lysaker, 2011); functioning (Lysaker et al., 2011j) and social cognition (Lysaker et al., 2012).	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAS-A subscales and total score
27 USA sample 4 (SSR: 41-46)	1. Firmin et al. (2017) 2. Kukla et al. (2013)* 3. Minor et al. (2015a)	Investigates relationship between metacognition and determinants of stigma (Firmin et al., 2017), recovery controlling for symptoms (Kukla et al., 2013), and emotion, word use and functioning (Minor et al., 2015a) in people with schizophrenia already participated in a study investigating the effects of illness management and recovery.	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAS-A – the total score (Firmin et al., 2017; Minor et al., 2015a) and the self-reflectivity and decentration subscales (Kukla et al., 2013)

28 USA sample 5 (SSR: 46 – 81)	1. Hasson-Ohayon et al. (2018a)* 2. James et al. (2016) 3. James et al. (2018) 4. Leonhardt et al. (2015) 5. Luther et al. (2016a) 6. Lysaker et al. (2013b) 7. Lysaker et al. (2013c) 8. (Lysaker et al., 2015a) 9. Lysaker et al. (2015c) 10. Minor and Lysaker (2014) 11. Minor et al. (2015c)* 12. Minor et al. (2019) 13. Schnakenberg et al. (2016)	Investigates relationships between metacognition and its various subscales with variables including symptoms (Lysaker et al., 2015b; 2015c; Minor & Lysaker, 2014; Minor et al., 2015c; 2019); social functioning (James et al., 2016; 2018); distress, symptoms and sexual abuse (Leonhardt et al., 2015); motivation (Luther et al., 2016a); stigma, depression and insight (Lysaker et al., 2013c); and cannabis use (Schnakenberg et al., 2016) in people with scizhophrenia who already participated in a study investigating the effects of cognitive remediation. Some studies controlled for symptoms, neurocognition, social cognition antipsychotic medication use as appropriate (Hasson-Ohayon et al., 2018a; Lysaker et al., 2013b).	NS: PANSS: (FS: Bell et al., 1994, plus individual items) Metacognition: MAS-A subscales and total score
29 USA sample 6 (SSR: 14 – 40)	1. Francis et al. (2017) 2. Leonhardt et al. (2017a) 3. Mehdiyoun et al. (2015) 4. Vohs et al. (2014) 5. Vohs et al. (2015b)* 6. Vohs et al. (2015c)	Investigates relationships between metacognition and brain structures (Francis et al., 2017; Vohs et al., 2015b), insight (Leonhardt et al., 2017b; Vohs et al., 2015c), stigma (Mehdiyoun et al., 2015) in individuals with FEP, who already participated in RCTs investigating cognitive therapy or MERIT. Vohs et al. (2014) investigated social cognition in comparison to a group with prolonged psychosis.	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAS-A subscales and total score (Vohs et al., 2015c excludes decentration)
30 USA sample 7 (SSR: 54-56)	1. Bonfils et al. (2016) 2. Bonfils et al. (2018)*	Investigates relationships between metacognition and its subscales with emotional awareness, self-esteem and hope (Bonfils et al., 2016) and distress tolerance and empathy (Bonfils et al., 2018) in people with schizophrenia already participating in a study of Narrative Enhancement Cognitive Therapy.	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAS-A subscales (Bonfils et al., 2018 interested in Self-Reflectivity only)
31 USA sample 8 (SSR: 58)	1. Bonfils (2017) 2. Bonfils et al. (2019)	Investigates relationship between metacognition and personal distress and empathy task performance in people with schizophrenia.	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAS-A - only Bonfils (2017) reports total score
32 USA sample 9 (SSR: 56)	1. Luther et al. (2020)	Investigates whether metacognition, clinical insight or neurocognition moderated the relationship between self-reported and clinician-rated motivation measures in people with schizophrenia who participated in a randomised pilot trail of a text-message intervention targeting motivation.	N: PANSS (individual items) Metacognition: MAS-A total score

33 China sample (SSR: 70 – 77)	1. Wu et al. (2015a) 2. Wu et al. (2015b)	Investigates relationship between metacognition and empathy (Wu et al., 2015a), and theory of mind compared to people with anxiety disorder (Wu et al., 2015b).	N: PANSS (FS: Kay et al., 1987) Metacognition: MAS-A - no adaptations reported in English

Databases arranged in alphabetical order of country from which data collected, followed by year in which dataset first published.

*** = studies which have been condensed into one record based on similarity of information. See other records contributing in appendix 2**

AAI: Adult Attachment Interview; **BPRS:** Brief Psychiatric Rating Scale; **CBT:** Cognitive Behavioural Therapy; **FEP:** First Episode Psychosis; **FS:** Factor Structure; **IPII:** Indiana Psychiatric Illness Interview; **MAI:** Metacognition Assessment Interview; **MAS-A:** Metacognition Assessment Scale – Abbreviated; **MERIT:** MEtacognitive Reflection and Insight Therapy; **NS:** Negative Symptoms; **PANSS:** Positive and Negative Syndrome Scale; **SSR:** Sample Size Range

Table 4.3: Summary of overlapping datasets identified from systematic search

Overlapping participant samples	Reports which measure or report on data for participants in these datasets	Description of research reported for these data	Negative symptoms and metacognition measures used
Sample 1: Scotland sample 2 and 3 (SSR: 34 – 79)	1. MacBeth et al. (2016)*	Investigates the relationship between metacognition, negative symptoms and help seeking in a FEP sample.	NS: PANSS (FS: van der Gaag et al., 2006) Metacognition: MAS-R understanding of one's own, and others', minds subscales - ratings generated from AAI interviews.
Sample 2: USA sample 2 and 3 (SSR: 20-166)	1. Buck et al. (2014)* 2. Lolley (2012) 3. Lysaker et al. (2014d) 4. Lysaker et al. (2014e) 5. Ringer et al. (2013) 6. Snethen et al. (2014) 7. Vohs et al. (2016)	Investigates the relationships between metacognition and variables including symptoms (Buck et al., 2014; Lysaker et al., 2014e; Ringer et al., 2013), personality syndromes (Lolley, 2012), discreet metacognitive capacities (Lysaker et al., 2014d); physical activity (Snethen et al., 2014) and gamma activity (Vohs et al., 2016) in people with schizophrenia who already participated in studies investigating cognitive therapy and work outcome. Studies controlled for variables such as social cognition and symptoms where appropriate.	NS: PANSS (FS: Bell et al., 1994) - Lolley (2012) interested in general psychopathology alone. Metacognition: MAS-A subscales and total score
Sample 3: USA sample 3 and 5 (SSR: 75)	1. Vohs and Lysaker (2014)	Investigates relationship between mastery and intrinsic motivation over time in individuals with prolonged schizophrenia already participating in a study of CBT versus supportive psychotherapy.	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAS-A mastery subscale
Sample 4: USA sample 2, 3 and 5 (ssr: 175)	1. Luther et al. (2016b)	Investigates relationships between metacognition and functioning and the mediating role of motivation, controlling for neurocognition, symptoms and social cognition in people with schizophrenia.	NS: PANSS (FS: Bell et al., 1994) Metacognition: MAS-A total score

Sample 5: USA samples 2, 3, 4, 5, 6 and 7 (SSR: 103-334)	1. Gagen et al. (2019) 2. Lysaker et al. (2017) 3. Lysaker et al. (2019)	Investigates metacognition across different diagnostic groups controlling for symptoms and insight (Lysaker et al., 2017), the relationship between these variables in adults with schizophrenia (Lysaker et al., 2019), and the relationship between these variables and social functioning (Gagen et al., 2019).	NS: PANSS (FS: Bell et al., 1994, plus individual items) Metacognition: MAS-A.

Databases arranged in alphabetical order of country from which data collected, followed by year in which dataset first published.

*** = studies which have been condensed into one record based on similarity of information. See other records contributing in appendix 2**

AAI: Adult Attachment Interview; **CBT:** Cognitive Behavioural Therapy; **FEP:** First Episode Psychosis; **FS:** Factor Structure; **MAS-A:** Metacognition Assessment Scale – Abbreviated; **MAS-R:** Metacognition Assessent Scale – Revised**; NS:** Negative Symptoms; **PANSS:** Positive and Negative Syndrome Scale; **SSR:** Sample Size Range

Figure 4.1: PRISMA Flow Diagram

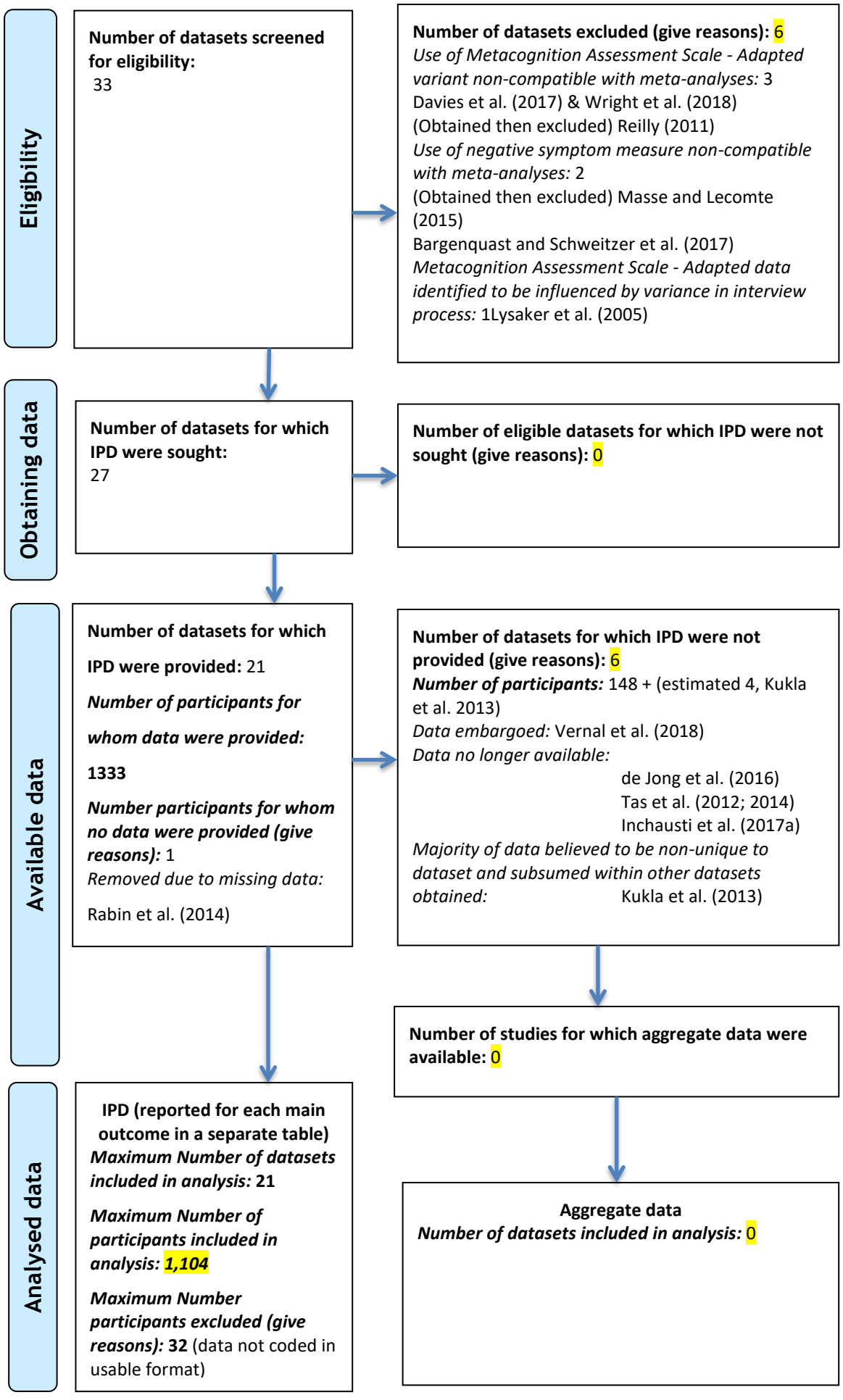
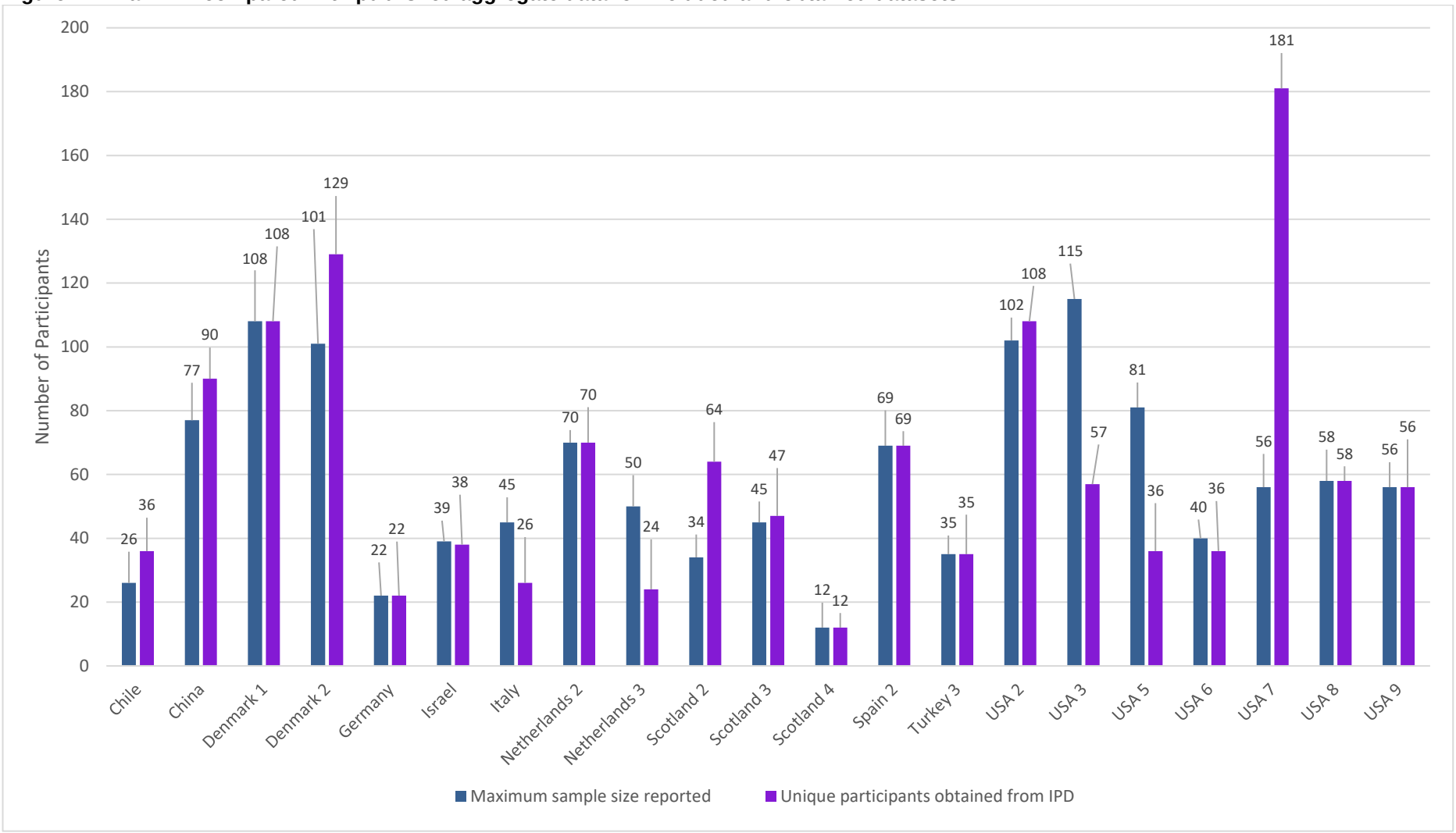


Figure 4.2: Raw IPD compared with published aggregate data for included and obtained datasets



4.4.2 Description of IPD obtained

Data were obtained in an anonymised and otherwise unaltered form (excluding one participant who was removed due to missing data from one sample (Rabin et al., 2014)). Data were cleaned, and co-authors assisted with translation of databases where necessary. There were a few minor errors apparent in data entry and coding (i.e. some sum-scores had been computed incorrectly), and these were identified through checking procedures using components of these scores where these were available (see appendix 10).

Appendix 10 shows that all recruited participants provided at least partial requested data (assuming no further cleaning of the dataset by the original authors had occurred). Nine datasets reported data on the 35 variables of interest. Education was the most common variable which was systematically unsuitable or unavailable across a total of 9 datasets, with the primary reason that data were unsuitable for comparison being that data were collected as a categorical variable around level of education rather than years of education. This slightly impacts covariate analyses but not the main analyses. Four datasets only included the PANSS-ONS total and two datasets (Abu-Akel & Bo, 2013; Luther et al., 2020) only collected specific individual PANSS items. Computation of summed scores were computed where required. The BELLCOG and VDGCOG data for one sample (Rabin et al., 2014) were not requested as analyses involving these variables were conducted post-hoc; however, these data were available in other samples. Overall data were comparable for meta-analyses with the majority of data available for analyses.

Given that samples varied greatly in their size and demographic characteristics, (i.e. sample ranges of 11-181 participants across datasets and First Episode Psychosis (FEP) and MEP samples with a range of ages), we meta-analysed the age, gender, and education of participants across datasets, allowing comparisons which provide equal weighting to participants in each study. These are described in Table 4.4.

Table 4.4: IPDMA estimates of the demographic and clinical profile across datasets

Demographic and clinical variables	Weighted Average (Standard Error)
Age	36.97 (2.029)
Proportion of males	71%
Years of education[1]	11.54 (0.672)
Negative Symptom Scores	**Weighted Average (Standard Error)**
Experiential Negative Symptoms[2]	8.279 (0.459)
Expressive Negative Symptoms[2]	9.238 (0.499)
PANSS-ONS[3]	18.165 (0.683)
PANSS-BNS[3]	18.949 (0.808)
PANSS-VDGNS[3]	18.858 (0.757)
Metacognition Scores	**Weighted Average (Standard Error)**
SR: Self-Reflectivity[4]	4.178 (0.249)
UOM: Understanding Others' Minds[4]	2.983 (0.215)
D: Decentration[4]	0.816 (0.169)
M: Mastery[4]	3.377 (0.262)
Total Metacognition[4]	11.505 (0.520)

1. Note 9 datasets did not contribute to this figure

2. Only 15 of the 21 datasets contributed to these figures, scores of a possible 3-21 for Experiential Negative Symptoms (NS) and 4-28 for Expressive NS.

3. Possible scores range from 7-49 (PANSS-ONS), 8-56 (PANSS-BNS), and 2 – 62 (PANSS-VDGNS).

4. Possible score ranges for each scale are 0-9 (SR/M), 0-7 (UOM), 0-3 (D), 0-28 (Total Metacognition)

4.4.3 Meta-analyses of IPD

Table 4.5 represents results of IPDMAs for the relationship between metacognition and each negative symptom subscale and summed score variation. They are grouped by the metacognition subscale or total score which was being examined as a potential predictor. Fifteen datasets contributed to each IPDMA (apart from the PANSS-ONS meta-analyses where 19 datasets contributed) based on available data. All significant results indicate a negative relationship between metacognition and negative symptoms, indicating that deficits in metacognition are likely to result in higher levels of negative symptoms. Appendix 11 reports results for individual negative symptoms.

Table 4.5: IPDMA estimates of relationship between metacognition and negative symptoms

Negative Symptom Item(s)	Association with Self-Reflectivity (Beta, 95% CI)	Association with Understanding Other's Minds (Beta, 95% CI)	Association with Decentration (Beta, 95% CI)	Association with Mastery (Beta, 95% CI)	Comparison with Total Metacognition (Beta, 95% CI)
PANSS-ONS	*-0.281 (-0.560 - -0.003)*[1]	*-0.410 (-0.775 - -0.045)*[3]	-0.377 (-0.760 – 0.005)	-0.447 (-0.987 – 0.093)	*-0.688 (-0.855 - -0.521)*[4]
PANSS-VDGNS	-0.015 (-0.051 - 0.021)	-0.034 (-0.099 – 0.030)	-0.022 (-0.084 – 0.040)	-0.009 (-0.032 – 0.015)	*-0.475 (-0.614 - -0.335)*[4]
PANSS-BNS	-0.033 (-0.077 - 0.010)	-0.065 (-0.141 – 0.010)	-0.057 (-0.158 – 0.045)	-0.029 (-0.0.69 – 0.011)	*-0.512 (-0.636 - -0.389)*[4]
Experiential Negative Symptoms	-0.001 (-0.006 – 0.005)	-0.003 (-0.019 – 0.014)	-0.001 (-0.018 – 0.018)	-0.001 (-0.004 – 0.003)	*-0.114 (-0.171 - -0.056)*[4]
Expressive Negative Symptoms	*-0.032 (-0.063 - -0.001)*[2]	-0.053 (-0.107 – 0.001)	-0.043 (-0.112 – 0.025)	-0.018 (-0.041 – 0.004)	*-0.323 (-0.397 - -0.249)*[4]

p-values: 1. 0048; 2. 0.049; 3. 0.028 4. <0.00

The effect size was largest for comparisons between total MAS-A and negative symptoms, regardless of which factor structure was used (i.e. PANSS-ONS, β = -0.688). There were small and significant relationships between the PANSS-ONS and self-reflectivity, understanding others' minds, with the latter showing the strongest association (β= -0.410, CI = -0.775 to -0.045). Expressive negative symptoms were also associated with self-reflectivity, although the strength of relationship was much lower (β = -0.032, CI = -0.063 - -0.001). Of these results, heterogeneity was highest for PANSS-ONS (I^2 = 85.9% for the multivariate meta-analysis comparing this subscale with all domains of metacognition) and lowest for expressive negative symptoms compared with self-reflectivity (I^2 < 0.1%). Further examination of heterogeneity included reflections on Forest and Funnel Plots of the preceding univariate analyses (reported in appendix 12).

Across all models, right skew was present in many regression models. It was too computationally complex to transform these analyses within the final meta-analytic models used. However, using REML to estimate the meta-analyses may have helped correct for this. Some regression models also appeared non-linear, and this may have influenced the significance of some final results. For example, both the experiential and PANSS-VDGNS models appeared non-linear across several datasets when plotted against total metacognition (examples given in appendix 13). Alternatively, studies with small samples may have contributed to the differences in the patterns of these relationships across datasets (IntHout et al., 2015). Again, by analysing data on aggregate through meta-analysis, and using REML, many of these issues were minimised.

All individual negative symptom items apart from G14 and G16 (poor impulse control (an atypical negative symptom) and active social avoidance respectively), were significantly associated with total metacognition (β range: -0.029 to -0.101). In comparison, in analyses of individual negative symptoms, N6 (lack of spontaneity and flow of conversation, which may reflect the ability to obtain social support) was the only item which showed a significant association with any subdomain of the MAS-A (mastery), and the relationship was extremely small (β = -0.007). However, the heterogeneity for these analyses appeared much higher (e.g. I^2 for original negative symptoms subscale compared with total MAS-A = 90.7%).

4.4.4 Sensitivity analyses

Given that the original total negative symptoms subscale was the most strongly associated with metacognition across all analyses, it seemed appropriate to consider whether this may have been due to disorganisation items (which were removed from the negative symptoms subscale in subsequent factor analytic solutions) contributing significantly to the relationships observed. Therefore, *post-hoc* IPDMA were conducted using BELLCOG and VDGCOG compared with levels of metacognition (described further in appendix 14). Mastery was the only domain significantly related to cognitive disorganisation items using both factor structures (BELLCOG: ß = -0.071, 95%CI = -0.126 to -0.016, VDGCOG: ß = -0.098, 95%CI= -0.179 to -0.017). These factor structures had a moderate relationship with total metacognition (BELLCOG: ß = -0.589, CI = -0.714 to -0.465 and VDGCOG: ß = -0.445, CI = -0.528 to -0.361). Heterogeneity was low for both analyses (I^2 = 6.8% and 0.1% respectively). The effect sizes shown for total metacognition associations are similar to the PANSS-VDGNS and PANSS-BNS (i.e. all moderate) and show considerably overlapping Confidence Intervals.

Taking these findings together, it was also considered that differences between first- and multi- episode samples may have been a cause for heterogeneity amongst the findings. Analyses were repeated removing the first-episode sample datasets (MacBeth et al., 2014; McLeod et al., 2014; Trauelsen et al., 2016; Vohs et al., 2014). Relationships between total metacognition and all negative symptoms and cognitive disorganisation items remained statistically significant. The significant relationships between self-reflectivity and understanding others' minds and PANSS-ONS were not retained after removing FEP samples due to increased uncertainty of estimate. The significant relationship between expressive negative symptoms and self-reflectivity, or between mastery and lack of spontaneity (N6), and BELLCOG and VDGCOG were also not retained for the same reason. The MEP only analyses didn't show any stronger or more precise estimates compared with analyses using all datasets (summarised in appendix 15). There were not enough datasets for it to be deemed feasible to conduct the same analyses on the FEP samples alone.

Sensitivity analyses involving investigating differing configurations of the data are also described in appendix 16. These results indicate similar findings to

those reported above and demonstrate that these findings are not due to the use of unstandardized coeffcients.

4.4.4.1 Covariate analyses

Those analyses which were statistically significant were examined in meta-analyses that included covariates which were commonly reported across most studies (age, gender and education), again using Seemingly Unrelated Regression to account for the existing correlation between these variables (described in full in appendix 17). All summed scores relationships with MAS-A components remained significant after controlling for these variables, except the relationship between total metacognition and experiential negative symptoms and PANSS-VDGNS. Interestingly, of the relationships between the total MAS-A scores and individual negative symptoms, only Poor Rapport, Lack of Spontaneity and Flow of Conversation, and Stereotyped thinking (N3, N6 and N7 respectively) remained significant when controlling for covariates.

Some beta coefficients in the covariate analyses were larger than in the original meta-analyses (i.e. the relationship between Self-reflectivity and PANSS-ONS was –0.389 in the covariate analyses versus –0.281 in the original meta-analyses). This may be because the original meta-analyses used SUR to include all metacognitive subscales, which may have driven down the association between any one subscale and negative symptoms. Consistent with this, covariate analyses with total metacognition (where the original meta-analyses did not use SUR), showed smaller beta coefficients than the original meta-analyses (i.e.–0.211 when covariates are included versus –0.688 in the original meta-analyses). This indicates that covariates may explain some of the relationship between negative symptoms and metacognition, but perhaps not as much as the other correlated domains of metacognition.

The heterogeneity for these analyses was in most cases smaller than the heterogeneity shown in analyses not controlling for covariates (reductions range from a 4.6% - 68.2% decrease in heterogeneity), with only the relationship between mastery and N6 showing an increase by 15.8% in heterogeneity when controlling for covariates, although this relationship was no longer statistically significant.

4.5 Discussion

We aimed to conduct a meta-analysis of individual participant data exploring the relationship between domain-specific negative symptoms and components of metacognition. Hypotheses 1.1 and 2.1 were partially supported. Negative symptoms, when summed to provide a total score (by various factor analyses), experiential and expressive subscale scores, and as individual items were significantly related to total metacognition, but with high heterogeneity, particularly for PANSS-ONS. Self-reflectivity and understanding others' minds were found to be independently associated with PANSS-ONS only, and expressive negative symptoms were associated with self-reflectivity. All associations were negative suggesting higher levels of negative symptoms is associated with lower metacognition.

The relationship between expressive negative symptoms, and PANSS-VDGNS and total metacognition didn't remain significant after controlling for covariates, and only individual expressive negative symptoms (poor rapport (N3), lack of spontaneity (N6), and stereotyped thinking (N7)) remained significant in covariate analyses with total metacognition. Lack of spontaneity also showed a significant relationship with mastery which was not retained when controlling for covariates. Separately, there was a small, significant, negative association between cognitive disorganisation and mastery. Sensitivity analyses suggested that the contribution of disorganisation items, FEP samples, or the configuration of data, including non-standardised scale data, are not key drivers of these findings, given that these sensitivity analyses show largely overlapping results with the original IPDMAs.

Hypothesis 3.1 is generally supported, as IPDMA reported were generally more comprehensive than aggregate data in terms of ability to answer review questions. Data was generally consistent with that reported in published articles, with mean negative symptom and metacognition scores being within the observed statistics reported in the systematic review. Datasets were generally clean with few imputation errors and reported a mix of PANSS negative symptoms items and subscale scores and MAS-A data. Only four datasets reported no individual negative symptom items and two datasets reported a subset of the individual items only. Education was often systematically missing or recorded categorically could not be converted to a similar enough format for

comparison (9 datasets in total). All datasets (apart from two samples (Breustedt, 2017; McLeod et al., 2014)) had over 70% of data available, with MAS-A data being the most commonly incomplete variable. Eight datasets had 100% complete data provided.

These findings should be viewed in line with the methodological considerations of this study. Thirty-three datasets were considered for this meta-analysis, of which 6 were excluded due to using different metacognition measures (plus 32 participants from one additional dataset), and 6 datasets were unavailable. Those remaining 21 datasets all measured negative symptoms using the Positive and Negative Syndrome Scale and metacognition using the Metacognition Assessment Scale (Adapted). Given that the systematic review (Chapter 2) identified significant associations between metacognition and negative symptoms using alternative measures (such as the MAS-R and measures of intrinsic motivation), the findings of this meta-analyses do not fully capture current evidence exploring the relationship between metacognition and negative symptoms. Nonetheless, this meta-analyses is the most robust assessment of the literature to date: the final sample of 1270 participants (1119 of which had 100% complete or only systematically missing data) is estimated to be 87.14% representative of the published data.

Contrary to expectations, the results suggest that negative symptoms and metacognition, when treated as summed scores, are more strongly related to each other than when treated as individual negative symptoms or metacognitive domains. While this does suggest the relationship between metacognition and negative symptoms is important, with moderate-sized associations shown, it also raises questions around why more granular analysis did not demonstrate significant associations. Lack of measurement variability in certain analyses may have contributed to findings, as individual items on the PANSS have a narrower score range than the total score, as do metacognitive domains versus total metacognition. However, there were no substantial differences in results when controlling for this difference in variability through sensitivity analysis.

The representativeness of the sample may have contributed to findings: the weighted average in the overall sample was 11.51 (of a possible 30) for total metacognition and 18.2 (of a possible 49) for negative symptoms. The lack of increased precision or effect size in examining only MEP samples in this meta-

analysis could be qualified by the majority being outpatient samples and only ten participants had PANSS negative symptoms summed scores above 33. Therefore, lack of individuals demonstrating more severe negative symptoms and metacognitive deficits might have impacted the ability to observe significant associations if these are more concretely associated with poor metacognition on the higher end of the negative symptom spectrum. Indeed, other areas of psychology are impacted by obscured differences between subgroups of people with similar symptoms (Agelink van Rentergem et al., 2021; Harald & Gordon, 2012) and researchers have called for better understanding of ways in which people with negative symptoms can be reliably differentiated (Galderisi et al., 2021b) given the heterogeneity in negative symptom experience (Stiekema et al., 2018b). Research must recruit more severe negative symptom samples or potentially important treatment targets may not have adequate empirical evidence. It is also important to establish through future research whether metacognitive deficits are causally implicated in the development and maintenance of negative symptoms, or rather whether severe negative symptoms lead to presentations involving a disrupted experience of self.

One key implication of these findings is that the association between metacognition and negative symptoms is not consistent across measurement categories, raising several research and clinical implications. Perhaps measures which offer a more granular understanding of metacognition are required to understand whether individual components of metacognitive ability impact on negative symptoms such as the MAS-Revised (Carcione et al., 2010a). Alternatively, the PANSS may have a less differentiated and experience-driven evaluation of negative symptoms in comparison to newer measures (Bucci & Galderisi, 2017) suggesting it may be useful to compare findings with results on the Clinical Assessment Interview for Negative Symptoms (Kring et al., 2013) or the Brief Negative Symptoms Scale (Kirkpatrick et al., 2011). Although findings don’t confirm a causal association between metacognition and negative symptoms, therapies such as Metacognitive and Reflective Insight Therapy (Lysaker et al., 2020a; van Donkersgoed et al., 2016) and Metacognition-Oriented Social Skills Training (Inchausti et al., 2017b), which have already been explored in relation to negative symptoms, should perhaps be investigated further to assess whether they produce metacognitive changes leading to

improvements in negative symptoms, given the negative association demonstrated.

The strengths of this meta-analysis include the collation of a large proportion of available evidence, the systematic assessment of available data and attempts to control for interrelated constructs. Several methodological limitations also restrict the veracity of these conclusions. Although IPDMA is generally recognised to be a highly powered type of analysis (Belias et al., 2019), several datasets contained small samples which may have impacted on heterogeneity statistics (IntHout et al., 2015). Given that most samples were below 100 participants data loss would have been too great to have constrained analyses by dataset sample size. Several analyses in the study were exploratory and should be investigated in novel datasets to confirm whether these results can be replicated. Finally, alternative negative symptom factor analyses could have been used, although there is currently no consensus on which of these are optimal (Galderisi et al., 2021b).

4.6 Conclusions

In conclusion, this meta-analysis provides the most comprehensive exploration of the relationship between metacognition and negative symptoms in existing data to date. These findings suggest that summary scores reflecting composite measures of negative symptoms are associated with metacognitive deficits. However, further consideration should be given to theoretical perspectives around the development and maintenance of negative symptoms, including whether this association is more prevalent in persons with more severe negative symptoms and whether metacognition is causally implicated in negative symptom development. Additionally, this meta-analysis highlights the importance of accounting for variance in the measures used to capture those experiences. Focused explorations of the association between negative symptoms and metacognition, with more granular analysis of changes over time, is recommended.

Chapter 5: Negative symptoms and associations with attachment, metacognition and mentalisation in adults in mental health services

5.1 Abstract

Introduction Reflection on self-experience, measured by metacognition and mentalisation, is commonly disrupted in people with psychosis and may impact on service engagement. These capacities have not been compared in people experiencing negative symptoms, despite more targeted treatment mechanisms being required. As mentalisation is a developmental construct, attachment classification may also be important. Here, attachment classification, mentalisation and metacognition were expected to predict levels of service engagement and negative symptoms in a psychosis sample.

Methods An existing dataset recruited 79 individuals and explored measures of negative symptoms, service engagement, mentalisation, metacognition, and adult attachment classifications in adult mental health settings over 12 months. This dataset was subjected to pre-registered secondary data analysis. Associations between constructs were explored with correlation analyses. Regression was used to examine differences in levels of negative symptoms and service engagement over time when participants were grouped by attachment classification, controlling for metacognition and mentalisation capacities. Stepwise regression and path analyses were used to explore robustness of associations and accommodate for the interrelatedness of independent variables.

Results Metacognition, but not mentalisation was correlated with negative symptoms, (strongest correlation= -0.34). No significant predictors were identified for outcomes at time one, however across longitudinal analyses all configurations of negative symptoms and service engagement were significantly predicted by that outcome variable at the preceding time point. Decentration was a significant predictor of all negative symptom classifications (β= -0.44 – -0.623) and understanding others' minds predicted levels of expressive deficits (β= 0.23), but not in the direction anticipated. Consistent with these models, stepwise regressions identified significant predictors from the multiple regression analyses as the most influential in determining variance in negative

symptoms. Path models only showed acceptable fit statistics when attachment was modelled as a predictor of metacognition and reflective function versus these variables being simply correlated. Avoidant attachment predicted levels of total negative symptoms and expressive deficits and metacognition scores predicted experiential deficits. Reflective function was not a significant predictor of negative symptoms.

Discussion The contribution of attachment classification, metacognition and mentalisation to predicting negative symptom scores was partially supported in linear regression and path models. However, only some subscales of metacognition (decentration and understanding others' minds), and avoidant attachment, significantly predicted levels of negative symptoms. The potential role of negative symptoms as a safety behaviour in response to problems understanding others is discussed as is the non-significant role of reflective function in this dataset. As service engagement also had mixed associations, these relationships appear complex. Given the better path model fit, it is possible there is a top-down relationship between attachment and metacognition and mentalisation which influences the relationship between these variables and negative symptoms. A replication study utilising similar variables is required to clarify the reliability of these findings.

5.2 Introduction

The previous chapters have outlined that negative symptoms are a relatively poorly understood and operationalised construct, particularly in the metacognition literature. Negative symptoms significantly impact on functioning and recovery (Best et al., 2016; Strauss et al., 2010). Therefore, better understanding of mechanisms which can be targeted in interventions for negative symptoms is needed to produce more effective treatments (Lutgens et al., 2017a; Lincoln & Peters, 2019). Metacognition, conceptualised across a spectrum of activities ranging from discrete to more synthetic capacities have been consistently related to negative symptoms (Hamm et al., 2012; Kukla & Lysaker, 2020b). The integrative model of metacognition, describing the capacity to synthesise increasingly complex information to make sense of oneself and others, the social world, and ways of responding to psychological distress (Lysaker et al., 2020c) is perhaps more consistently related to negative symptoms over time (Lysaker et al., 2015a; McLeod et al., 2014). However,

Chapters 3 and 4 demonstrated that metacognition can be assessed at various levels of granularity, and it is unclear to what extent different metacognitive capacities operate independently. This is important to establish as this might indicate how best to target metacognition in negative symptoms treatment.

There are several measures of metacognition identified in this thesis which focus on how individuals make sense of complex narratives related to themselves and others (including the Metacognition Assessment Scale - Revised, Carcione et al., 2010b; and the Metacognition Assessment Interview, Semerari et al., 2012). However, while these have subtle differences in their conceptualisation of metacognition (i.e. whether specific capacities should be treated hierarchically, whether subdomains are amalgamated, and the level of granularity at which individual metacognitive capacities should be scored); they are all derived from the same epistemological standpoint. Specifically, each of these measures was developed from the Semerari et al. (2003) model of metacognition which conceptualises self-reflectivity, understanding others' minds; decentration and mastery explicitly. While arguably applicable to any psychotherapy patient, this model was developed through clinical observation of individuals with borderline personality disorder diagnoses and difficulties with emotion regulation (Semerari et al., 2003; 2007). Subsequently the development of the MAS-A was largely based on individuals with experiences of psychosis who were categorised as having low insight (Lysaker et al., 2005). Although both versions of the scale intended to explain cognitive difficulties, they are relatively untested and undeveloped across populations who experience a whole spectrum of metacognitive capacities other than individuals with psychosis, nor is it rooted in a basis of developmental or cognitive milestones (Ridenour et al., 2019).

This chapter discusses in more detail the related construct of mentalisation; defined as a sense-making process for self and others' subjective states and mental processes (Bateman & Fonagy, 2010). Mentalisation overlaps with definitions of metacognition in that it relates to an understanding of one's own and others' mental states. However, mentalisation is rooted in a developmental and attachment-oriented understanding of reflective capacity (Luyten et al., 2020a). The construct of attachment, and attachment discourse related measures such as mentalisation, also exhibit a strong evidence base, but their

association with negative symptoms requires further exploration within this chapter.

Evidence also suggests that negative symptoms are predictive of poorer service engagement (Johansen et al., 2011; MacBeth et al., 2013a). There are intuitive reasons why identifying mechanisms through which service engagement can be improved for people with negative symptoms is important. Further to this, negative symptoms are associated with a higher proportion of a sealing over recovery style, where psychosis experience is minimised or treated separately to other areas of an individuals' life, and this in turn is associated with low service engagement (Vender et al., 2014). This suggests it might be important to understand if there are independent factors which impact on both negative symptoms and service engagement. Therefore, understanding the relationship between metacognition, attachment classification and mentalisation with negative symptoms might give further understanding to how service engagement in people with negative symptoms could be impacted. However, given associations between attachment and mentalisation with service engagement in people with psychosis (Gumley, 2011), there is value in examining associations between these constructs directly.

This chapter offers a rationale for exploring the relationship between metacognition, mentalisation and attachment classification in order to understand whether any of these constructs exhibit a stronger relationship with negative symptoms than another. Similarly, the relationship between these constructs and service engagement is explored. The methods and results of a secondary data-analysis are presented and discussed, which explore how attachment organisation, metacognition and mentalisation impact on negative symptoms and service engagement for persons with psychosis.

5.2.1.The attachment system

The relationship between attachment (the capacity from infancy to form working models of relationships by learning which actions are necessary to engage caregivers; Fonagy et al., 1998) and some symptoms of psychosis, particularly paranoia, is well established (Lavin et al., 2020). Persons with psychosis exhibit difficulties with service engagement that are related to their attachment categorisation (Gumley et al., 2014c; MacBeth et al., 2016) and it

has been recognised that attachment theory should inform mental health service delivery (Bucci et al., 2015). Currently, there is little research exploring the mechanisms that link attachment, negative symptoms and service engagement.

Adult attachment is commonly measured from narratives about relationships elicited by questions in the Adult Attachment Interview (the AAI; see Hesse, 2008 for full discussion). Through interview questions and probes, this categorises an individual's views and responses to invitations to consider early childhood relationships. The interview is scored against several parameters and coders arrive at a composite score classifying attachment. These classifications include three "organised" patterns of relating. In secure-autonomous attachment, caregiver and infant relationships are valued and the individual appears to be able to objectively evaluate their experiences. There are two types of insecure attachment: insecure-avoidant, where attachment relationships are devalued and insecure-preoccupied, where attachment relationships are a source of attention and focus. In addition, individuals' attachment representations can also be classified as disorganised, where no one pattern of relating is most evident, or in some instances attachment responses are not classifiable (because they are contradictory; George et al., 1996).

Research shows that these classifications are reliable predictors of attachment at different developmental stages (Groh et al., 2014) and show similar patterns of insecure versus secure attachment in various clinical groups (Bakermans-Kranenburg & van IJzendoorn, 2009). While some findings are inconsistent, recent reviews and meta-analyses suggest that insecure attachment is more prevalent in psychosis versus non-clinical samples, perhaps linked to increased likelihood of experiences associated with insecure attachment (Carr et al., 2018; Lavin et al., 2020). Insecure attachment is associated with increased interpersonal difficulties, poor service engagement, frequent and lengthy hospitalisations, trauma and low levels of parental bonding in psychosis (Gumley et al., 2014c).

Examining the AAI narrative coherence scale, internal consistency of participants' dialogue indicates greater objectivity in understanding ones' experiences and is associated with secure-autonomous attachment(Hesse, 2008).

This indicates that reflective capacity is critical to attachment classification, highlighting the importance of mentalisation (Hesse, 2008).

5.2.2 Mentalisation

The construct of mentalisation was developed in response to variation in reflections on self and others in AAI transcripts, and has been validated in adult samples, demonstrating effectiveness in predicting attachment classifications in their infant children and correlation with the narrative coherence scale (see review; Katznelson, 2014). Mentalisation emerges in the context of affect-laden interactions with a caregiver through activation of the attachment system (Fonagy et al., 1998). The ability of an infant's caregiver(s) to flexibly attune to, understand and respond to infant signals forms a basis through which that infant develops an understanding of their own and others' mental states (Bateman & Fonagy, 2013). The development of mentalisation can be supported by secure attachment; where there is often a high quality of attunement between caregiver and child (Brent & Fonagy, 2014a). In comparison, in insecure preoccupied and avoidant attachment categorisations, interactions are often characterised by persistent focus on or minimising of the relationship with the caregiver respectively, and the level of attunement in these interactions is lower. As early research demonstrates, when a caregivers' mentalisation is low, infants are more likely to experience insecure attachment which can result in turn in infant mentalisation being underdeveloped (Katznelson, 2014).

Although secure attachment confers benefits for mentalisation, mentalisation capacity can also be developed (or inhibited) through engagement with other social motivational systems (such as competing for resources or rank, alliance building, and sexual pair bonding; Liotti & Gilbert, 2011). The important commonality thought to allow mentalisation to flourish in each of these contexts is a feeling of social safeness. These conditions may be more intuitively and easily achieved through activation of the attachment system (when securely attached), but individuals may feel social safeness when engaging in altruism or alliance building, or when in a position of dominant social rank. Later work has categorised these conditions as a general experience of epistemic trust; the ability to receive and assimilate information that is trustworthy, as a precondition for mentalisation that is most adaptively (but not exclusively)

developed within the activation of the attachment system (Luyten et al., 2020a).

Mentalisation literature arguably defines some of the ways through which more discrete and more synthetic mentalisation can be distinguished (see Luyten et al., 2020a for full discussion). Firstly, mentalisation can be automatic (involving fast, relatively unconscious thought processes) versus controlled (typically verbal and conscious and more elaborated) processes. It can also be based on internal information (generation of arguably more integrated inferences) compared to reliance on external cues (using cues such as gestures, tone of voice and facial expression), which arguably are more focused on assessing the accuracy of another's expression. Similarly, components of mentalisation can be differentiated by their cognitive or affective focus. Cognitive components of mentalisation include the integration of perspective taking (including the notion that others may view the world differently, similar to decentration) and reasoning based on an estimation of another's desires. However, this is likely to be increasingly integrated with affective components of mentalisation at the higher levels of reflective functioning (although these processes are relatively automatic). Finally, each of these components can be used in understanding the mental states of the self or others.

As an affective capacity, one major factor that distinguishes mentalisation from other metacognitive concepts is that it is posited to regulate emotional states and intense emotional states can dysregulate mentalisation. Furthermore, Fonagy and Luyten (2016) describe mentalisation capacity being modulated as individuals respond to attachment relationships by hyperactivating or deactivating the attachment system. Mentalisation can also be disrupted through modes where individuals may struggle to take on the perspective of others (psychic equivalence), integrate internal information (teleological mode) or ground reflections in reality (pretend mode). Attachment security is likely to impact on activation of these strategies also. Again, Luyten et al. (2020a) provides a full discussion.

Attachment and mentalisation are related across several clinical groups including those with experiences of psychosis (Lavin et al., 2020; Boldrini et al., 2020; Korver-Nieberg et al., 2015; Outcalt et al., 2016). Additionally, in persons with

psychosis, insecure attachment often coincides with problems of mentalisation including difficulties understanding the minds of others and the ability to regulate negative and unwanted emotions (Gumley, 2010). Mentalisation is measured by the Reflective Functioning Scale which focuses on the ability to make sense of mental states and social interactions in response to affect-laden interactions (Fonagy et al., 1998), and is derived from the AAI. It represents mentalisation at a completely integrated level where understanding of oneself is assessed in relation to one's place in the world and relationship with others (Fonagy et al., 1998) and has been shown to operate as a single-factor construct (Taubner et al., 2013).

5.2.3 Similarities and distinctions between metacognition and mentalisation

Although the role of attachment and affect regulation lead to mentalisation being conceptualised somewhat differently to metacognition, both share substantial conceptual and empirical overlap. Both operate in support of overarching social motives (such as social rank, peer cooperation and autonomy; Dimaggio et al., 2017; Luyten et al., 2020b; see Ridenour et al., 2019 for a full discussion). Each distinguish lower-level functioning (e.g. whether someone has the same knowledge as you) to more higher-order cognitive processes, including for example the ability to recognise how multiple emotions or experiences may influence someone's actions, and that with the same information two individuals may have differing interpretations of an event (Fonagy et al., 1998; Lysaker et al., 2011a). Both constructs are also thought to inhibit and/or exacerbate stress responses to adverse circumstances (Luyten et al., 2020b; Lysaker et al., 2020b), and fluctuate in the moment (Ridenour et al., 2019).

However, their conceptualisation and measurement may influence their degree of shared similarity. Both metacognition and mentalisation are derived from narrative elicited with interviews such as the Indiana Psychiatric Illness Interview (Lysaker et al., 2002a) and Adult Attachment Interview (George et al., 1996) respectively. Each give individuals opportunities to display increasingly complex levels of reflection on one's life experience although reflections are derived in relation to differing concepts: low insight in psychosis; and attachment experiences. Both are hierarchical in that the preceding level of reflective capacity must be demonstrated for a higher level of reflection to be

awarded. Reflective functioning is more integrated in comparison to the MAS-A, where subcomponents are described as semi-independent (Lysaker et al., 2014d).

Empirically, neither measure requires the use of a specified interview and studies have demonstrated adequate use of the MAS-A with other narratives (see Bo et al., 2015; and Bröcker et al., 2017 regarding use of MAS-A; and Katznelson, 2014 regarding use of Reflective Functioning). However, it is possible that the narratives most commonly generated do impact on the reflections given. For example, the AAI has an explicit caregiver focus which is designed to illicit narratives from childhood, which may generate significant affect, whereas these are not explicitly requested in the IPII. These narratives are likely to generate significant affect. Ultimately, both capacities are likely to fluctuate in response to the personal relationships discussed (Hasson-Ohayon et al., 2020; Luyten et al., 2020b) and level of affect this generates. However, if the AAI captures reflective capacity in affect-laden interactions more reliably than the IPII, the fluctuation of metacognition in response to affect might not be as reliably demonstrated by this measure. This could impact differences in the relationship between these two measures and other constructs.

5.2.4 The impact of metacognition and mentalisation on levels of mental distress and their role in treatment

Low levels of metacognition and mentalisation are both associated with experiences of psychosis (Luyten et al., 2020b; Lysaker et al., 2020d) and have been linked to higher rates of insecure attachment in these groups (Dimaggio & Lysaker, 2015; Aydin et al., 2016). However, these concepts are relatively unexplored in relation to each other or specific symptoms. In theory, negative symptoms may be associated with down-regulating the attachment system, which could have implications which are synonymous with negative symptoms themselves (such as social withdrawal, and difficulties anticipating affect, Gumley & Liotti, 2018). In these instances autobiographical experiences of attachment may be under-elaborated, possibly indicating lower levels of reflectivity which is consistent with both deficits in mentalisation and metacognition (Schwannauer, 2013). Some studies suggest that these capacities are required for effective emotion regulation and will undoubtedly affect functioning, and experiences of affect (Ascone et al., 2020; Ludwig et al., 2020).

In research, a relationship between attachment and negative symptoms (Gumley et al., 2014c), mentalisation (Luyten et al 2020) and metacognition (Aydin et al., 2016) has been established. Of negative symptoms specifically, negative symptoms and metacognition are also shown to co-vary over time (McLeod et al., 2014) and are inversely related. Evidence also suggests that attachment and negative symptoms are longitudinally related (Gumley et al., 2014b). There is a lack of research evidencing a relationship between mentalisation and negative symptoms. This may be due to small sample sizes (e.g. this contributed to the non-significant relationship between mentalisation and all psychopathology observed in MacBeth et al., 2011), and perhaps due to most research focusing on positive symptoms (Korver-Nieberg et al., 2015; Gumley et al., 2014a). Research exploring attachment, reflective capacity and negative symptoms in concert is also limited. Poorer metacognitive abilities are related to attachment classification and symptoms in persons with other mental health difficulties including borderline personality disorder (Outcalt et al., 2016), but there is limited evidence exploring the same in persons with psychosis.

This points to gaps in current understanding of these constructs as they have not been compared collectively in people who experience negative symptoms. It is important to understand these relationships to determine suitable treatment targets. Additionally, given that some of these constructs (attachment patterns and metacognition) are shown to be related to service engagement (MacBeth et al., 2016), it is important to establish the ways in which they impact on help-seeking behaviour. This chapter therefore describes a study using an existing dataset (Gumley et al., 2014b) containing data on negative symptoms, service engagement and measures of metacognition, mentalisation and attachment organisation. The study aimed to assess whether reflective functioning and MAS-A scores explain variance in the relationship between attachment and negative symptoms and service engagement, which has not been systematically examined.

5.2.5 Hypotheses

1. Levels of negative symptoms, service engagement, metacognition and mentalisation will differ significantly in participants grouped by attachment classification. Secure-autonomous participants are predicted to have higher levels of mentalisation and metacognition, and the lowest

levels of negative symptoms in comparison to avoidant and preoccupied attachment groups.

2. In regression analysis, unit differences in negative symptoms across participants will be predicted by attachment classification, and variance in these scores will be further explained when also controlling for metacognition, mentalisation and negative symptom scores – in this sense, each predictor will exert a unique effect. The same will be true for regression with service engagement as the dependent variable.

3. Data will show a pathway from attachment classification to negative symptoms dependant on levels of metacognition and mentalisation in the exploratory path analysis.

5.3 Methods

5.3.1 Protocol

The study aims, hypotheses and analyses methods were pre-registered on aspredicted.org and can be accessed here: https://aspredicted.org/346_475.

5.3.2 Design

This will be a cross-sectional and longitudinal analysis of existing data (Gumley et al., 2014b). Data sharing and subsequent secondary data analysis has increasingly been called for in clinical research (Ross & Krumholz, 2013), mainly because it leads to increased resource value for the data already collected (through reducing the burden and cost associated with collecting new data to answer further research questions). This seems particularly relevant for this dataset where some variables collected have not been fully explored in relation to others (i.e. Reflective Functioning (RF) and MAS-A scores).

5.3.3 Participants

The original dataset included participants who took part in a 12-month study recruiting participants from Glasgow and Edinburgh. All were either inpatients or outpatients presenting to mental health services with a first episode of psychosis, meeting DSM-IV-TR criteria for any psychotic disorder (other than

psychotic disorders with a primary organic cause), as confirmed by semi-structured interview and clinician judgement. Additional exclusion criteria included head injury or substance misuse. 77.45% of approached participants agreed to take part in the research and provided baseline data (Gumley et al., 2014b).

5.3.4 Measures

The measures captured by the existing dataset and how they will be employed in this study are summarised below:

5.3.4.1 Psychopathology

The Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987) was completed following entry to the service and inter-rater reliability for these assessments were shown to be high (Gumley et al., 2014b). The PANSS items were analysed using the van der Gaag et al. (2006) factor structure. Only the negative symptoms subscale of this measure will be analysed here as these are the symptoms of interest in the study which totals 9 items (minus the score on a tenth item) with a possible score range of 2-62. Additionally, the negative symptoms can be separated into two distinct clusters, experiential and expressive negative symptoms. Khan et al. (2017) has shown that PANSS negative symptom items can be reliably separated into a two-cluster factor structure, and this will be used to explore differences between these symptom types. The experiential deficit cluster includes emotional withdrawal, passive/apathetic social withdrawal, and active social avoidance items; and the expressive deficit cluster includes blunted affect, poor rapport, lack of spontaneity and motor retardation items.

5.3.4.2 Service engagement

The Service Engagement Scale (SES; Tait et al., 2002) is a 14-item scale measuring four components of overall service engagement: availability, collaboration, help-seeking and treatment adherence. It was completed by clinicians in the original study and is rated between 0 and 42, where higher scores indicate lower levels of service engagement.

5.3.4.3 Adult attachment

The Adult Attachment Interview (AAI; George et al., 1996; Hesse, 2008) is a 20 question semi-structured narrative interview which asks individuals to recount experiences pertinent to their attachment relationships in childhood. For the purposes of this study, several coding systems (described below) will be applied to these transcripts.

AAI category coding

The AAI was coded by trained and reliable raters who allocate individuals to one of the categories specified above, organised (secure, avoidant or pre-occupied), or disorganised (unresolved). The 3-category coding of the AAI will be used for the purposes of this research. This is based on rating each interview on a series of nine-point scales classifying childhood experiences of receiving parenting and current state of mind regarding attachment including overall interview coherence. Individuals can then be classified as having “organised” attachment also known as “freely autonomous and secure”, where attachment experiences are regarded as influential and individuals are able to explore both positive and painful aspects of these, and also appear relatively independent.

Alternatively, interviews can be classified as either of the remaining “organised” categories, both of which represent an “insecure” attachment classification. Avoidant attachment is categorised by denial, minimisation or shutting down in response to discussing attachment experiences and also appear relatively independent. Preoccupied individuals appear confused in relation to attachment experiences and dialogue may show conflicted feelings, intense feelings of trauma and loss and reflections are prolonged, vague, and uncritical. Finally, where individuals show two or more indications of contradictory attachment strategies they are classified as having an unresolved attachment categorisation, usually seen in response to experiences of trauma and loss. Unresolved status will not be considered in the current analysis.

Reflective functioning

Like the MAS-A, Reflective Functioning (RF) is measured by a coding framework applied to participants’ responses to the AAI (Fonagy et al., 1998). It aims to measure individuals’ understanding of their own and others’ mental states.

Passages are rated for the level of RF demonstrated and then an overall rating is awarded ranging from -1 (negative RF) to 9 (exceptional RF). Similar to the MAS-A, higher ratings are awarded where reflections with increasing complexity are demonstrated.

Metacognitive functioning

The MAS-A (Metacognition Assessment Scale – Adapted (Semerari et al., 2003; Lysaker et al., 2005) is a coding framework that was applied to the AAI transcripts in this study for the purposes of subsequent research(McLeod et al., 2014), and gives four subscale scores and a total score of metacognitive capacity (ranging from 0-28). This includes:

- Self-Reflectivity - the ability to form increasingly complex representations of oneself and ones' mental states
- Understanding Others' Minds - the ability to make sense of others and form a complex narrative around others' thoughts and emotions
- Decentration - the ability to understand the world as separate from one's own view of it
- Mastery - the ability to use these representations to make sense of and manage psychological problems.

5.3.5 Procedure

The original researchers, who have also completed all ratings for the measures to be used in the analyses, have already collected all data required. The data were explored by the primary researcher in this study (NM) and checked for completeness, uniform reporting of units for each variable, and that units reported are valid (i.e. no PANSS negative symptom scores higher than the total possible score). Raw negative symptom items will be transformed to create additional variables for the PANSS experiential and expressive deficit domains.

5.3.6 Ethical considerations

Both the University of Glasgow Ethics and the NHS West of Scotland Research Ethics committee determined this study required no further ethical approval (see Appendix 18). All data were anonymised and processed in line with the ethical requirements of the original study.

5.3.7 Statistical analyses

All analyses were conducted in R Version 4.1.0 (code available at https://osf.io/b8wna/).

5.3.7.1 Primary analyses

Initially scatterplots were examined coding for attachment classification, exploring the relationship between metacognition, mentalisation and negative symptoms to assess for linearity. At each stage of analysis multivariate normality was also assessed through a histogram of residual values, which was compared to the results of a Q-Q plot and Shapiro-Wilk test for normality. Variance Inflation Factors and scatterplots between all variables were inspected to assess multicollinearity. Finally, homoscedasticity was tested using a plot of residuals versus fitted values.

All analyses were conducted in reference to the general linear model. To test hypothesis one dummy variable coding was used to examine the impact of attachment classification on negative symptoms, metacognition, mentalisation and service engagement. ANOVA tables and post hoc pairwise comparison tests allowed examination of the differences between groups. Analyses were then re-run for negative symptoms and service engagement controlling for baseline values of these variables. As expected, mean mentalisation and metacognition scores were significantly different in participants grouped by attachment classification, which confirmed the requirement for analyses testing hypothesis two to form a multiple regression analysis (as ANCOVA assumptions were violated). Hypothesis two was tested via multiple regression including all variables to examine the variance explained by each predictor. Stepwise regression analysis additionally assessed which variables were likely to explain the most variance in the models. Negative symptoms and service engagement were analysed in separate models.

Power calculation
We conducted an *a priori* power calculation for the primary models (linear multiple regression). To detect a large effect size with an alpha level of 0.05 and 80% power a sample size of 40 participants was required for the primary analyses, and 43 for the longitudinal models. To detect a medium effect size with the sample alpha and power parameters, a sample size of 85 and 92 would be required for the primary and longitudinal models respectively.

5.3.7.2 Exploratory analyses

Hypothesis 3 was tested by path analyses used to model causal relationships between the exogenous variables (AAI classifications (using dummy variable coding), MAS-A and RF scores), and endogenous variables (negative symptoms and help seeking). Goodness of fit was determined by Chi-Square, comparative fit index (CFI), Root Mean Square Error of Approximation (RMSEA) and Akaike Information Criterion (AIC) and Standardised Root Mean Square Residual (SRMR) statistics, where fit is assessed in line with guidelines described by Hooper et al. (2007). The Lavaan package in R version 3.6.1 was used.

5.4 Results

5.4.1 Descriptive statistics

Table 5.1 contains quantitative information characterising the sample included in analyses. Seventy-nine participants were included in the study with 26 removed from analyses due to missing data. There were partial missing data in a remaining 16 cases. The final number of participants contributing to comparisons involving service engagement cross-sectionally and longitudinally were 46 and 40 respectively, and 50 and 52 participants respectively contributed to cross-sectional and longitudinal comparisons involving negative symptoms. As per apriori power analyses this indicates that analyses were only powered to identify large effect sizes.

Table 5.1: Characteristics of sample of 79 participants

Continuous Variables				
Variable		**Mean**	**SD**	**N Missing data**
Age (years)		24.64	7.08	3
Duration of Untreated Psychosis (weeks)		44.37	73.96	8
Reflective Function		2.89	2.02	25
Self-Reflectivity		5.24	1.53	26
Understanding Others' Minds		4.38	1.06	
Decentration		1.58	0.69	
Mastery		4.21	1.13	
Total Metacognition		15.40	3.90	
Total Negative Symptoms	**T1**	16.68	9.45	3
	T2	13.10	7.59	12
Expressive Deficits	**T1**	7.75	4.86	3
	T2	6.40	4.26	12
Experiential Deficits	**T1**	7.63	4.18	3
	T2	5.51	3.60	12
Service Engagement	**T1**	11.08	8.80	16
	T2	13.00	10.05	16
Categorical Variables				
Variable		**Categories**	**N(%)**	**N Missing Data**
Gender		Male	54(68.35)	0
		Female	25(31.65)	
Ethnicity		White British	64(81.0)	1
		White Scottish	9(11.4)	
		Pakistani	1(1.3)	
		African	2(2.5)	
		Not disclosed	1(1.3)	
		Polish	1(1.3)	
Diagnosis		Schizophrenia	38(52.05)	6
		Schizophreniform Disorder	2(2.74)	
		Schizoaffective Disorder	8(10.96)	
		Delusional Disorder	1(1.37)	
		Bipolar Disorder	19(26.03)	
		Unknown	0(0)	
		Other	5(6.85)	
Attachment Classification		Secure: Freely Autonomous	17(31.48)	25
		Insecure: Avoidant	26(48.15)	
		Insecure: Preoccupied	11(20.37)	

T1: Time 1; **T2:** Time 2

5.4.2 Correlation analyses

We examined scatterplots of negative symptom data (explored as total score and expressive and experiential deficits) and service engagement compared with measures of metacognition (by subscale and total score) and reflective functioning, coding for attachment classifications. All plots indicated an inverse relationship between both metacognition (when treated as summed score or subscales) and mentalisation, and negative symptoms and service engagement. This suggests that as levels of metacognition and mentalisation increased, negative symptoms decreased and service engagement increased. A subset of these scatterplots are shown in Figure 5.1, indicating these relationships for the four main outcome variables (total negative symptoms, experiential and expressive deficits, and service engagement) in relation to mentalisation and total metacognition scores. As the metacognitive subscale scatterplots were similar and consistent with this, they are not shown here.

As Table 5.2 demonstrates, several of these variables were significantly correlated. Total negative symptoms were moderately associated with negative symptoms at subsequent timepoints ($r(64) = 0.38\text{-}0.49$, $p < 0.01$) across all categorisations of negative symptoms (experiential and expressive deficits and total negative symptoms score). Experiential and expressive deficits were strongly correlated at both timepoints ($r(64)= 0.73\text{-}0.76$, $p>0.001$). Total metacognition ($r(50)= -0.29$, $p=0.037$) and decentration ($r(50)= -0.32$, $p = 0.021$) showed a significant inverse association with total negative symptoms. No other components of the MAS-A were significantly related to negative symptoms. Experiential, but not expressive deficits were also significantly associated with total metacognition ($r(50)= -0.30$, $p= 0.029$) and decentration ($r(50)= -0.34$, $p=0.014$), and the association with decentration persisted over time ($r(48)= -0.31$, $p=0.030$).

Reflective functioning was not significantly related to negative symptoms or service engagement at any time points. Service engagement at time one was associated with all measures of negative symptoms at time two ($r(56)=0.43\text{-}0.46$, $p<0.001$) and concurrent service engagement and negative symptoms at time two were also moderately associated ($r(55)=0.35\text{-}0.39$, $p<0.01\text{-}0.015$). Metacognition, treated as a total score and as subscales were significantly correlated with each other and reflective function. Reflective functioning was

most ($r(51)= 0.57$, $p<0.01$) and least ($r(51)= 0.29$, $p<0.01$) strongly associated with understanding others' minds and mastery respectively.

Figure 5.1: Scatterplots of associations between outcomes and metacognition and mentalisation

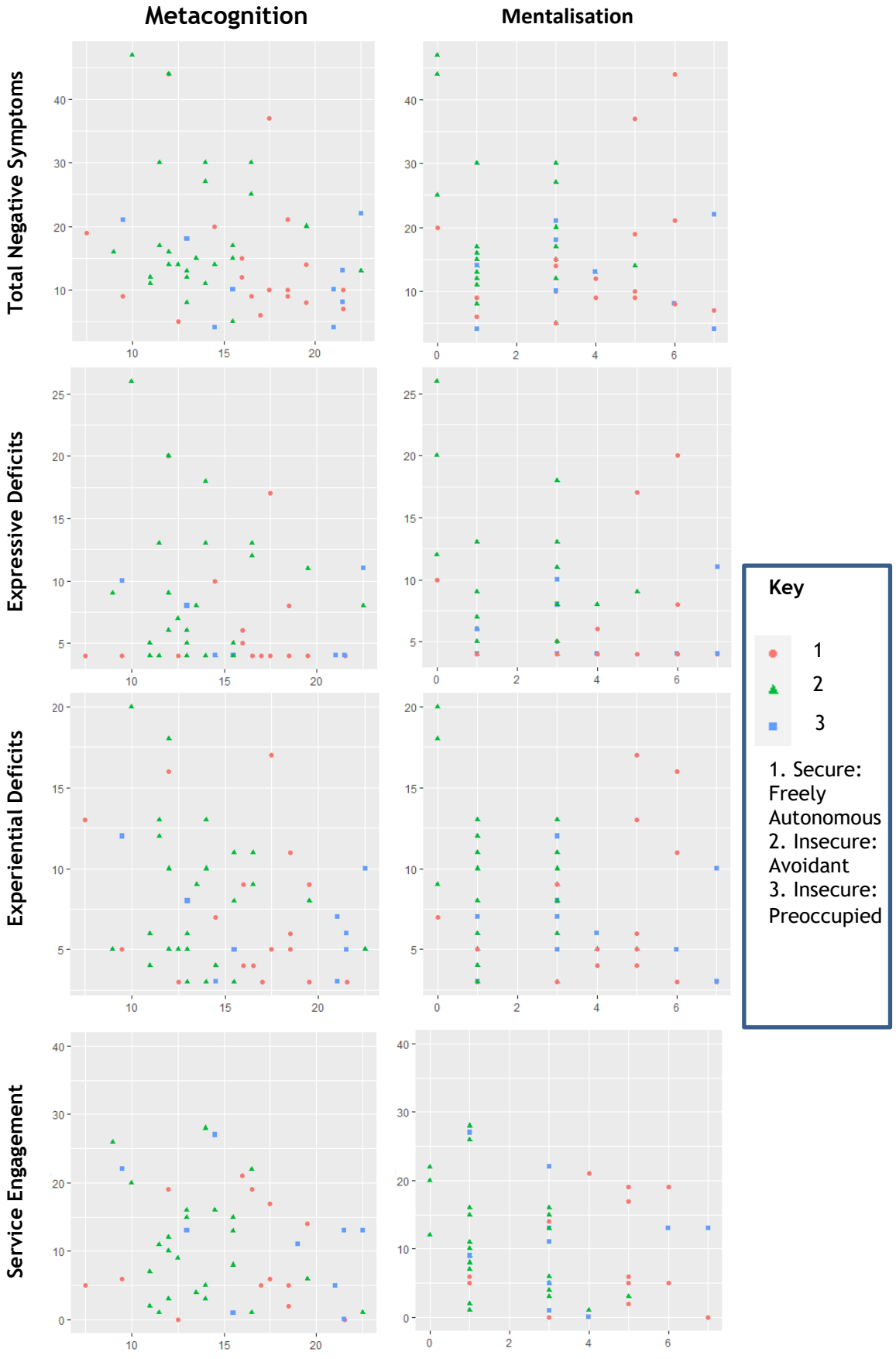


Table 5.2: Correlations between negative symptoms, service engagement, metacognition and reflective functioning:

	Total Negative Symptoms (Time 2)	Expressive Deficits (Time 2)	Experiential Deficits (Time 1)	Experiential Deficits (Time 2)	Service Engagement (Time 1)	Service Engagement (Time 2)	Total Metacognition	SR	UOM	D	M	Reflective Function
Total Negative Symptoms (Time 1)	0.49*				0.10	0.24	-0.29*	-0.25	-0.26	-0.32*	-0.23	-0.16
Total Negative Symptoms (Time 2)					0.46*	0.39*	-0.18	-0.17	-0.08	-0.29*	-0.14	-0.07
Expressive Deficits (Time 1)		0.48*	0.76*	0.27*	0.07	0.18	-0.24	-0.20	-0.18	-0.25	-0.25	-0.14
Expressive Deficits (Time 2)			0.45*	0.73*	0.43*	0.32	-0.15	-0.14	-0.03	-0.25	-0.13	-0.06
Experiential Deficits (Time 1)				0.38*	0.10	0.16	-0.30*	-0.26	-0.26	-0.34*	-0.24	-0.09
Experiential Deficits (Time 2)					0.43*	0.35*	-0.19	-0.19	-0.11	-0.31*	-0.11	-0.11
Service Engagement (Time 1)						0.54*	-0.22	-0.19	-0.16	-0.31*	-0.17	-0.20
Service Engagement (Time 2)							-0.14	-0.16	-0.08	-0.17	-0.10	0.09
SR									0.79*	0.87*	0.64*	0.52*
UOM										0.81*	0.50*	0.57*
Decentration											0.62*	0.56*
Mastery												0.29*
Reflective Functioning							0.54*					

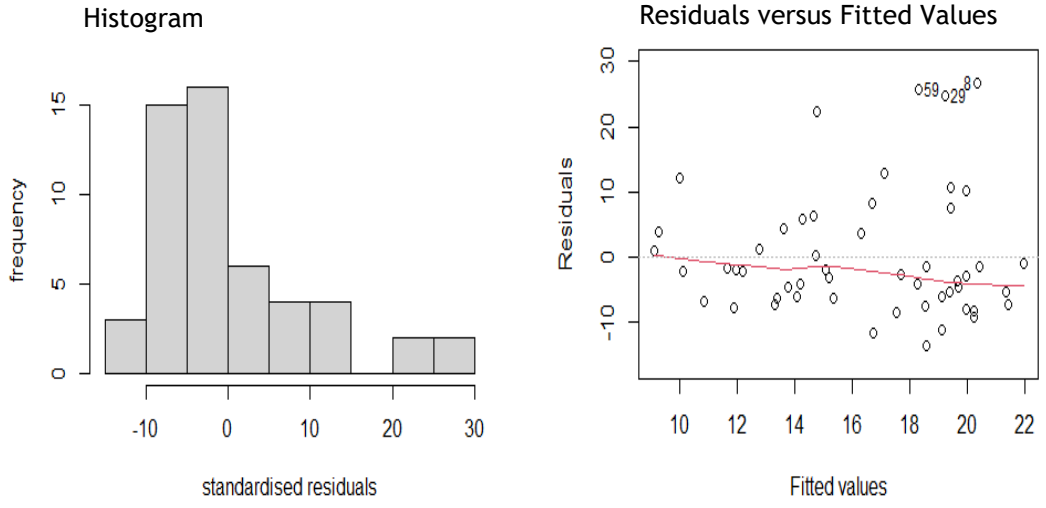
SR: Self-Reflectivity; **UOM:** Understanding Others' Minds; **D:** Decentration; **M:** Mastery

5.4.3 Regression analyses

It was anticipated, given the strong correlations between metacognition, reflective function and attachment classification, that an ANCOVA model to examine the impact of these variables on negative symptoms and service engagement would violate the homogeneity of regression slopes assumption. This was confirmed by the Levene's test result for reflective functioning ($p=0.21$) and total metacognition ($p=0.50$). A full description of the associations between metacognition and attachment classifications is described in Appendix 19. Further, a MANOVA was conducted examining the relationship between attachment classification and both metacognition (treated as a summed score) and mentalisation simultaneously. It confirmed that there was a statistically significant difference on combined metacognition and mentalisation scores when participants were grouped by attachment classification ($F(2,50) = 6.500$, $p<0.001$). All post-hoc pairwise comparisons were significant. Therefore, regression was used as per analyses plan.

Negative symptoms (summarised here by the total scale score) was positively skewed, as demonstrated in Figure 5.2, and did not meet Shapiro-Wilk test criterion for normality ($W=0.863$, $p<0.01$). Additionally, there was non-normal distribution of errors in these models indicating heteroscedasticity. Therefore, these data were log-transformed.

Figure 5.2: Examining normality before log-transformation for total negative symptoms



Regression models were conducted using dummy coding to treat attachment classifications as categorical. In simple regressions, ANOVA tables were used

post-hoc to identify which attachment classifications were significantly different from each other across outcome variables. Negative symptoms were compared as total scores, and also experiential and expressive deficits, and metacognition was also examined as a total score and as subcomponents of the MAS-A. The results of the primary analyses (multiple regression) at time two, which included the only overall models which emerged as significant are summarised in Tables 5.3-5.4. These are compared to some of the simple regressions (described in Appendix 19, where the other multiple regression findings are also summarised).

None of the primary regression models were significant at baseline. However, decentration emerged as a significant predictor in the multiple regression model examining associations with service engagement at time one (ß= -8.518, 95%CI= -16.568 - -0.468) and avoidant attachment emerged as a significant predictor of total negative symptoms at time one (ß= 0.298, 95%CI= -0.109 – 0.706). At time two, only the model exploring predictors of experiential deficits with metacognition categorised as a total score, as opposed to subscales, was non-significant (R^2= 0.205, p= 0.070). Models for total negative symptoms, expressive (but not experiential) deficits and service engagement were significant (R^2= 0.229-0.371, p= 0.008 – 0.041). However, for each model only the outcome score at the preceding time point was a significant predictor.

Exponentiated, total negative symptoms at time one predicted a 1.456% increase at time two (ß= 0.376, 95%CI= 0.149 – 0.603, p=0.006). Expressive deficits (also exponentiated) at time one explained a 39.48% increase at time two (ß= 3.675, 95%CI= 0.113 – 0.622, p=0.018). Service engagement difficulties at time one explained a 71.7% increase in service engagement difficulties at time two (ß= 0.717, 95%CI= 0.336 – 1.097, p= 0.001). Although the overall model was not significant, experiential deficits at time one were identified as a significant predictor of experiential deficits at time two (ß= 0.352, p=0.016, CI =0.070–0.634).

Table 5.3: Multiple regression models for relationships between negative symptoms and attachment, metacognition (treated as total score) and mentalisation at time two

DV	R^2	F	DF	p value	Predictor	β	SE	PValue	CI Low	CI High
Total Negative Symptoms (Time 2)	**0.273**	**3.232**	**43**	**0.015**	Avoidant	0.131	0.164	0.429	-0.200	0.461
					Preoccupied	0.051	0.184	0.781	-0.320	0.423
					Reflective Function	0.027	0.039	0.500	-0.052	0.106
					Total Metacognition	-0.007	0.019	0.727	-0.046	0.032
					Total Negative Symptoms Time 1	**0.376**	**0.113**	**0.002**	**0.149**	**0.603**
Expressive Deficits (Time 2)	**0.229**	**2.554**	**43**	**0.041**	Avoidant	0.092	0.180	0.327	-0.184	0.539
					Preoccupied	0.074	0.199	0.710	-0.327	0.476
					Reflective Function	0.013	0.043	0.710	-0.073	0.099
					Total Metacognition	<0.001	0.021	0.999	-0.042	0.042
					Expressive Deficits (Time 1)	**0.368**	**0.126**	**0.006**	**0.113**	**0.622**
Experiential Deficits (Time 2)	0.205	2.219	43	0.070	Avoidant	0.143	0.196	0.470	-0.253	0.539
					Preoccupied	-0.06	0.221	0.777	-0.509	0.383
					Reflective Function	0.023	0.048	0.627	-0.073	0.120
					Total Metacognition	-0.012	0.024	0.622	-0.060	0.036
					Experiential Deficits (Time 1)	**0.352**	**0.140**	**0.016**	**0.070**	**0.634**
Service Engagement T2	**0.371**	**3.779**	**32**	**0.008**	Avoidant	-0.885	3.679	0.811	-8.378	6.608
					Preoccupied	-3.831	4.396	0.390	-12.784	5.123
					Reflective Function	1.317	0.908	0.157	-0.534	3.167
					Total Metacognition	-0.339	0.417	0.422	-1.188	0.510
					Service Engagement (Time 1)	**0.717**	**0.187**	**<0.001**	**0.336**	**1.097**

DV: Dependent Variable, **DF:** Degrees of Freedom, **SE:** Standard Error, **CI:** Confidence Interval. Findings in **bold** are statistically significant

Table 5.4: Multiple regression models for relationships between negative symptoms and attachment, metacognition (treated as subdomains) and mentalisation at time two

DV	R^2	F	DF	P value	Predictor	ß	SE	P value	CI Low	CI High
Total Negative Symptoms (Time 2)	**0.372**	**2.960**	**40**	**0.011**	Avoidant	0.049	0.165	0.769	-0.284	0.381
					Preoccupied	0.095	0.182	0.603	-0.272	0.463
					Reflective Functioning	0.013	0.041	0.751	-0.069	0.096
					Self-Reflectivity	0.041	0.089	0.647	-0.139	0.222
					Understanding Others' Minds	0.205	0.107	0.064	-0.012	0.422
					Decentration	**-0.443**	**0.205**	**0.036**	**-0.856**	**-0.029**
					Mastery	-0.007	0.069	0.916	-0.146	0.132
					Negative Symptoms (Time 1)	**0.352**	**0.114**	**0.004**	**0.122**	**0.582**
Expressive Deficits (Time 2)	**0.345**	**2.630**	**40**	**0.020**	Avoidant	0.081	0.178	0.326	-0.279	0.441
					Preoccupied	0.126	0.194	0.518	-0.266	0.519
					Reflective Functioning	0.001	0.044	0.990	-0.088	0.089
					Self-Reflectivity	0.049	0.095	0.608	-0.143	0.242
					Understanding Others' Minds	**0.234**	**0.115**	**0.023**	**0.001**	**0.470**
					Decentration	**-0.512**	**0.216**	**0.023**	**-0.948**	**-0.076**
					Mastery	0.025	0.075	0.740	-0.126	0.175
					Expressive Deficits (Time 1)	**0.356**	**0.123**	**0.006**	**0.107**	**0.605**
Experiential Deficits (Time 2)	**0.327**	**2.424**	**40**	**0.031**	Avoidant	0.052	0.195	0.791	-0.342	0.446
					Preoccupied	-0.014	0.215	0.949	-0.448	0.421
					Reflective Functioning	0.016	0.049	0.752	-0.084	0.115
					Self-Reflectivity	0.071	0.106	0.504	-0.142	0.285
					Understanding Others' Minds	0.223	0.128	0.090	-0.036	0.483
					Decentration	**-0.623**	**0.245**	**0.015**	**-1.117**	**-0.129**
					Mastery	0.017	0.082	0.833	-0.149	0.184
					Experiential Deficits (Time 1)	**0.303**	**0.138**	**0.035**	**0.023**	**0.583**
Service Engagement (Time 2)	**0.400**	**2.42**	**29**	**0.039**	Avoidant	-1.187	3.812	0.758	-8.983	6.609
					Preoccupied	-1.567	5.371	0.773	-12.551	9.417
					Reflective Functioning	1.359	0.955	0.165	-0.594	3.312
					Self-Reflectivity	-2.070	2.554	0.424	-7.294	3.154
					Understanding Others' Minds	2.360	2.859	0.416	-3.487	8.207
					Decentration	-3.717	5.001	0.463	-13.945	6.512
					Mastery	1.002	2.000	0.620	-3.088	5.091
					Service Engagement (Time 1)	**0.674**	**0.199**	**0.002**	**0.267**	**1.081**

DV: Dependent Variable, **DF:** Degrees of Freedom, **SE:** Standard Error, **CI:** Confidence Interval. Findings in **bold** are statistically significant

Models for all outcomes were significant when metacognition was treated as four separate subscales of the MAS-A (R^2= 0.327-0.372, p= 0.012 – 0.031). The score for each outcome at baseline were significantly associated with each outcome at time two (β= 0.303 – 0.356, 95%CI lower =0.023 – 0.122, 95%CI upper = 0.582 – 0.605, p= 0.004 – 0.035). When included as subdomains, components of metacognition also emerged as significant predictors of negative symptoms treated as total scores and experiential and expressive deficits. Decentration emerged as a significant predictor of all categorisations of negative symptoms (β= -0.44 - -0.623, 95%CI lower= -0.857 - -1.117, 95%CI upper= -0.029 - -0.129). Understanding others' minds was also a significant predictor of expressive deficits (β= 0.23, 95%CI>0.001 – 0.467). The direction of significant associations between understanding others minds and negative symptoms were opposite to what was predicted, suggesting that increased metacognition was associated with higher levels of negative symptoms, but could be a spurious finding given closeness to non-significance. In contrast associations with decentration were in the anticipated direction whereby reduced decentration abilities were associated with higher levels of negative symptoms. Across analyses, models of service engagement did not show associations with any metacognitive capacities or reflective functioning. A full breakdown of the influence of each variable in these models is described in Appendix 19.

These findings are generally consistent with the simple regression models conducted as part of assumption checks, where neither avoidant or preoccupied attachment classification were associated with any classification of negative symptoms or service engagement at either time point. However, the overall models for negative symptoms (but not service engagement) were significant, suggesting a small amount of variance in negative symptoms is explained by attachment (R^2 = 0.048 – 0.135). Furthermore, the difference between preoccupied and avoidant attachment was significant in participants grouped by total negative symptoms (-0.533 lower negative symptoms in the avoidant attachment group compared to secure attachment, p=0.031). Additionally, participants grouped by attachment classification significantly differed on levels of metacognition and reflective functioning for avoidant attachment (except for understanding others' minds and mastery).

Stepwise regressions were also conducted using forward selection with baseline data only to check stability of the findings from the multiple regressions. In models where metacognition was treated as a total score, avoidant attachment was associated with the largest variance in total negative symptoms and expressive deficits and total metacognition was associated with the largest variance in experiential deficits and service engagement. This is contrary to the multiple regression models where no significant predictors were identified for outcome variables at time one.

When metacognition was broken into subdomains, decentration was the largest predictor of negative symptoms (except expressive deficits, where avoidant attachment was still the strongest predictor) and service engagement. This is consistent with multiple regression analyses for total negative symptoms, where decentration returned the largest beta coefficient, however the finding that more variance was explained by avoidant attachment than decentration in expressive deficits is inconsistent. Furthermore, understanding other's minds did not explain high levels of variance in negative symptoms in the stepwise regression despite being a significant predictor of expressive deficits in the multiple regression models. Consistent with the multiple regression model, decentration also contributed the most variance to service engagement scores. When only the most influential variables identified were computed in multiple models, decentration emerged as the only significant predictor of total negative symptoms and experiential deficits and service engagement. This is largely consistent with existing models, except that decentration did not explain high levels of variance in expressive deficits in the stepwise regression despite being identified as a significant predictor in the multiple regression model. There was therefore no evidence to support that any models were better explained by other predictors when poor predictor variables were removed.

5.4.4 Path analysis

Exploratory path analyses were conducted to examine the potential predictive links between attachment and metacognition and mentalisation in addition to the link between attachment and negative symptoms. Two theoretical perspectives were explored: one model where metacognition was predicted by attachment classifications and one model where metacognition and attachment classifications are correlated but one does not predict the other. These models

were constructed for each outcome (total negative symptoms, experiential and expressive deficits, and service engagement). The models were also compared over time to examine whether these associations also predict relationships between each categorisation of negative symptoms and service engagement at time two.

Given these aims, the original path models are fully saturated, meaning model fit cannot be assessed. Therefore, the association between attachment classification and negative symptoms was constrained to zero and the covariance (an unstandardised measure of correlation) between total metacognition and reflective functioning to one in a new iteration of each model to allow sufficient degrees of freedom to explore model fit. Models were compared with the Maximum Likelihood Robust (MLR) standard errors estimator in Lavaan which accounts for non-normally distributed data and heteroscedasticity by providing robust standard errors (Huber-White estimation) and a scaled test-statistic (equivalent to the Yuan-Bentler correction). Owing to the properties of MLR estimation, log-transformation of data was not required as non-normality is handled in estimation, however for the purposes of sensitivity analysis log-transformed path models were also conducted for negative symptom scores. Fit statistics were generally comparable across models. Parameter estimates excepting associations with log-transformed variables were also equivalent. Given complications in estimating and interpreting log-transformed models, these are not discussed further.

The robust estimates for constrained models are summarised in Table 5.5 and can be compared with standard estimates in Appendix 20. Version two models were indicated to be of poor fit across all model fit statistics with significant Chi-Square tests, low CFI indices (below 0.95), RMSEA indices or confidence intervals for these statistics below 0.08, and SRMR scores above 0.08. This indicates that models suggesting attachment classification predicts levels of metacognition had better fit than models treating these variables as simply correlated.

All Chi squares indicated good model fit for path models of negative symptoms (classified as total negative symptoms, experiential and expressive deficits) at both timepoints, and service engagement at time one. Of these model fit

statistics, only path models for total negative symptoms and expressive deficits at time one did not indicate acceptable model fit on CFI indices also (although notably some literature suggests the CFI indices reported would be acceptable for these models as they are above 0.9). RMSEA statistics were also acceptable for all categorisations of negative symptoms at time two and service engagement at time one (although it is relevant to note that confidence intervals were not within acceptable limits). This suggests that the coefficients for relationships between variables reported in Figures 5.3-5.6 have acceptable model fit statistics across multiple indices, except for service engagement at time two.

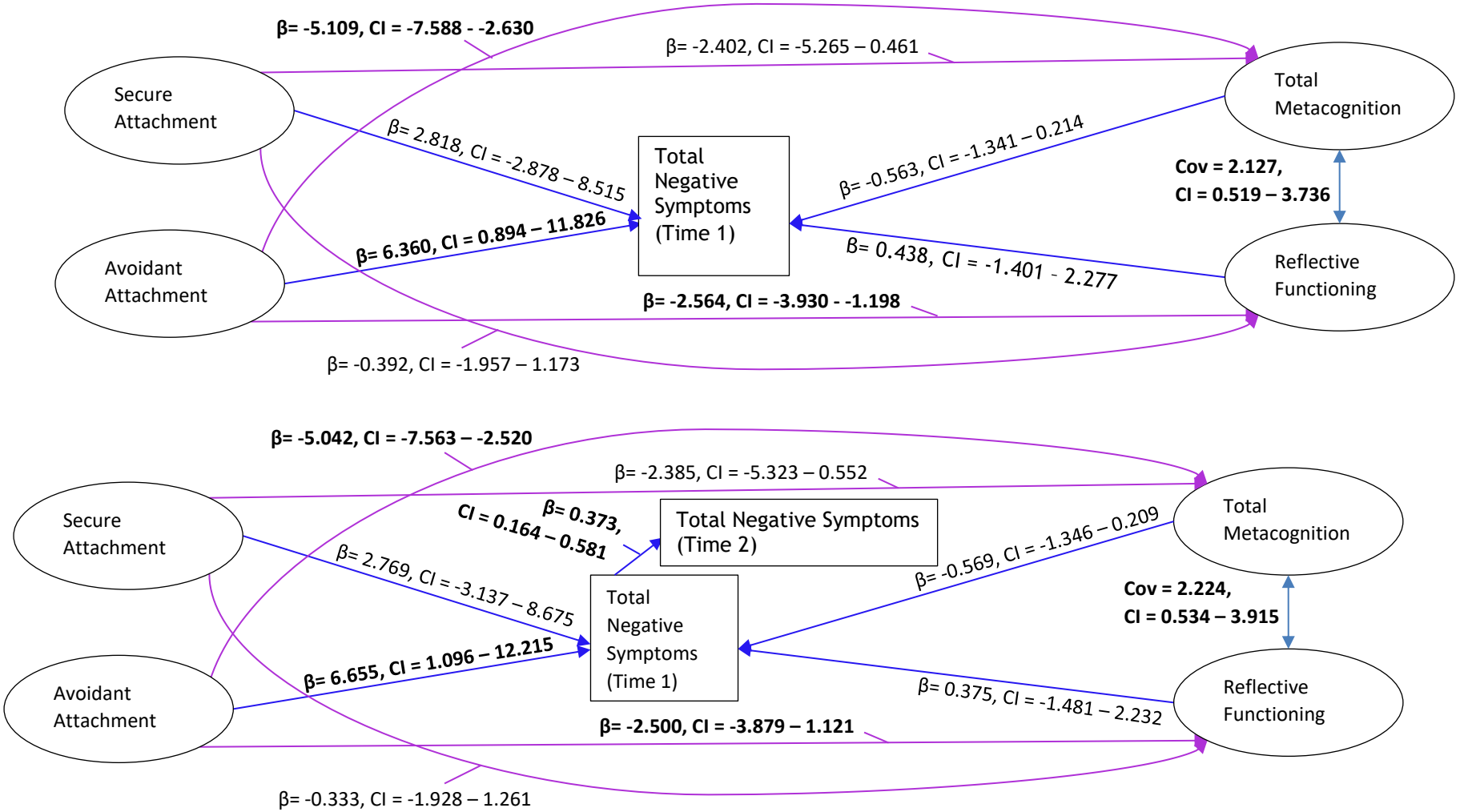
Table 5.5: Fit indices for all path models estimated with MLR

Outcome	Model	Chi Square Statistic	DF	P-Value	CFI	AIC	RMSEA	CI Low	CI High	SRMR
Total Negative Symptoms Time 1	1	6.148	3	0.105	0.944	867.565	0.122	>0.001	0.26	0.058
	2	40.632	4	>0.001	0.526	1015.893	0.412	0.303	0.531	0.262
Total Negative Symptoms Time 2	1	8.593	7	0.283	0.977	1159.514	0.056	>0.001	0.163	0.069
	2	46.416	8	>0.001	0.603	129.465	0.278	0.204	0.358	0.219
Expressive Deficits Time 1	1	7.573	3	0.056	0.927	798.149	0.139	>0.001	0.265	0.066
	2	43.791	4	>0.001	0.513	946.477	0.416	0.31	0.531	0.264
Expressive Deficits Time 2	1	9.129	7	0.244	0.967	1038.444	0.065	>0.001	0.167	0.078
	2	47.402	8	>0.001	0.579	1178.394	0.28	0.206	0.359	0.222
Experiential Deficits Time 1	1	4.564	3	0.207	0.973	777.686	0.085	>0.001	0.232	0.052
	2	39.724	4	>0.001	0.541	926.014	0.405	0.296	0.524	0.261
Experiential Deficits Time 2	1	6.668	7	0.464	1	1002.079	>0.001	>0.001	0.146	0.068
	2	42.982	8	>0.001	0.602	1142.029	0.272	0.195	0.354	0.218
Service Engagement Time 1	1	3.606	3	0.307	0.983	742.731	0.065	>0.001	0.051	0.063
	2	27.396	4	>0.001	0.582	867.98	0.364	0.243	0.498	0.239
Service Engagement Time 2	1	12.072	7	0.098	0.896	879.746	0.13	>0.001	0.251	0.077
	2	31.72	8	>0.001	0.642	981.318	0.268	0.174	0.369	0.22

Key	
Green	Acceptable fit statistics
Orange	Fit statistics only regarded as acceptable in some literature
Red	Unacceptable fit statistics

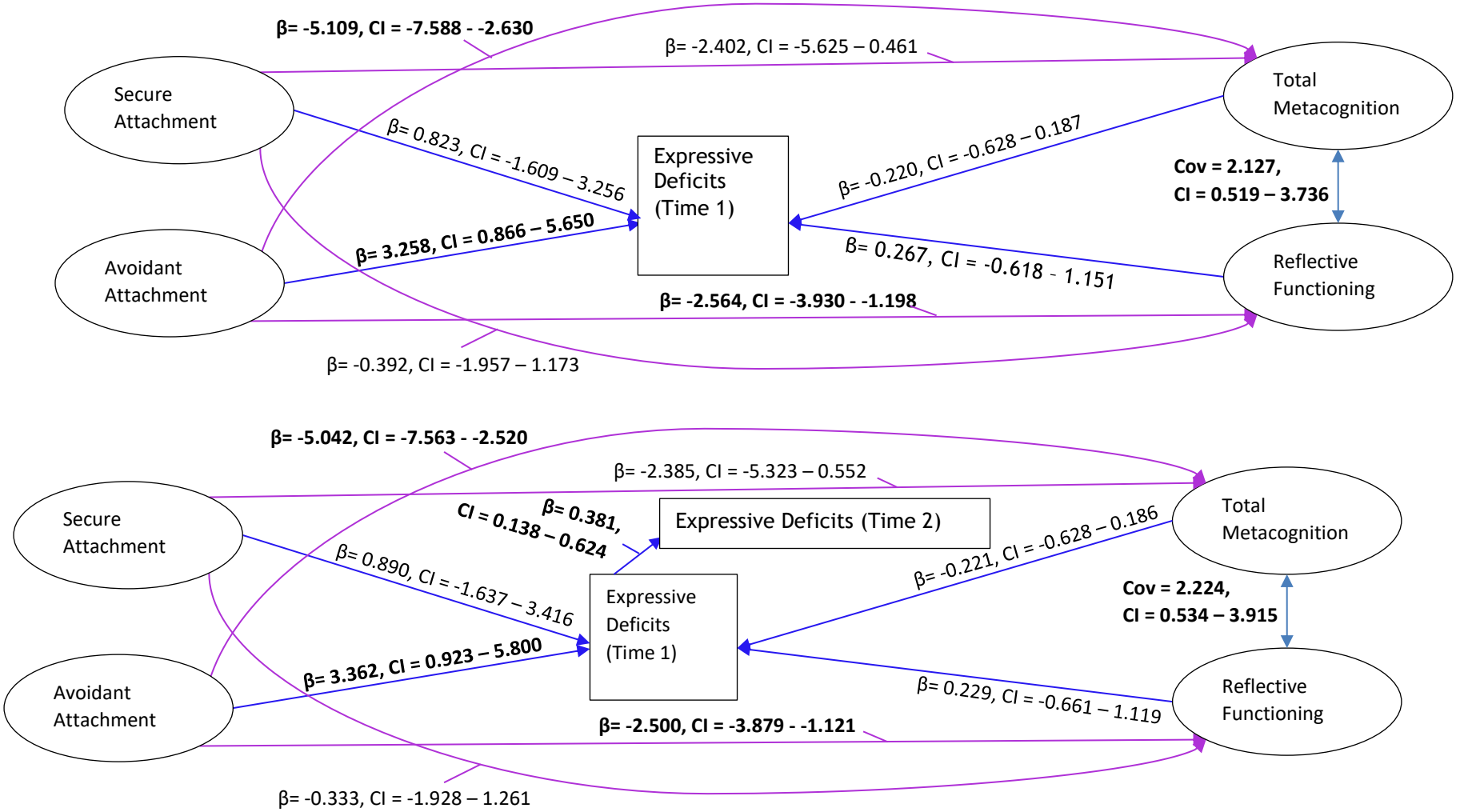
DF: Degrees of Freedom; **CFI:** Comparative Fit Index; **AIC:** Akaike Information Criterion; **RMSEA:** Root mean square error of approximation; **CI Low:** lower bound confidence interval; **CI High:** Upper bound confidence interval; **SRMR:** Standardised Root Mean Square Residual

Figure 5.3: Path models exploring attachment classification, metacognition and mentalisation as related predictors of total negative symptoms:



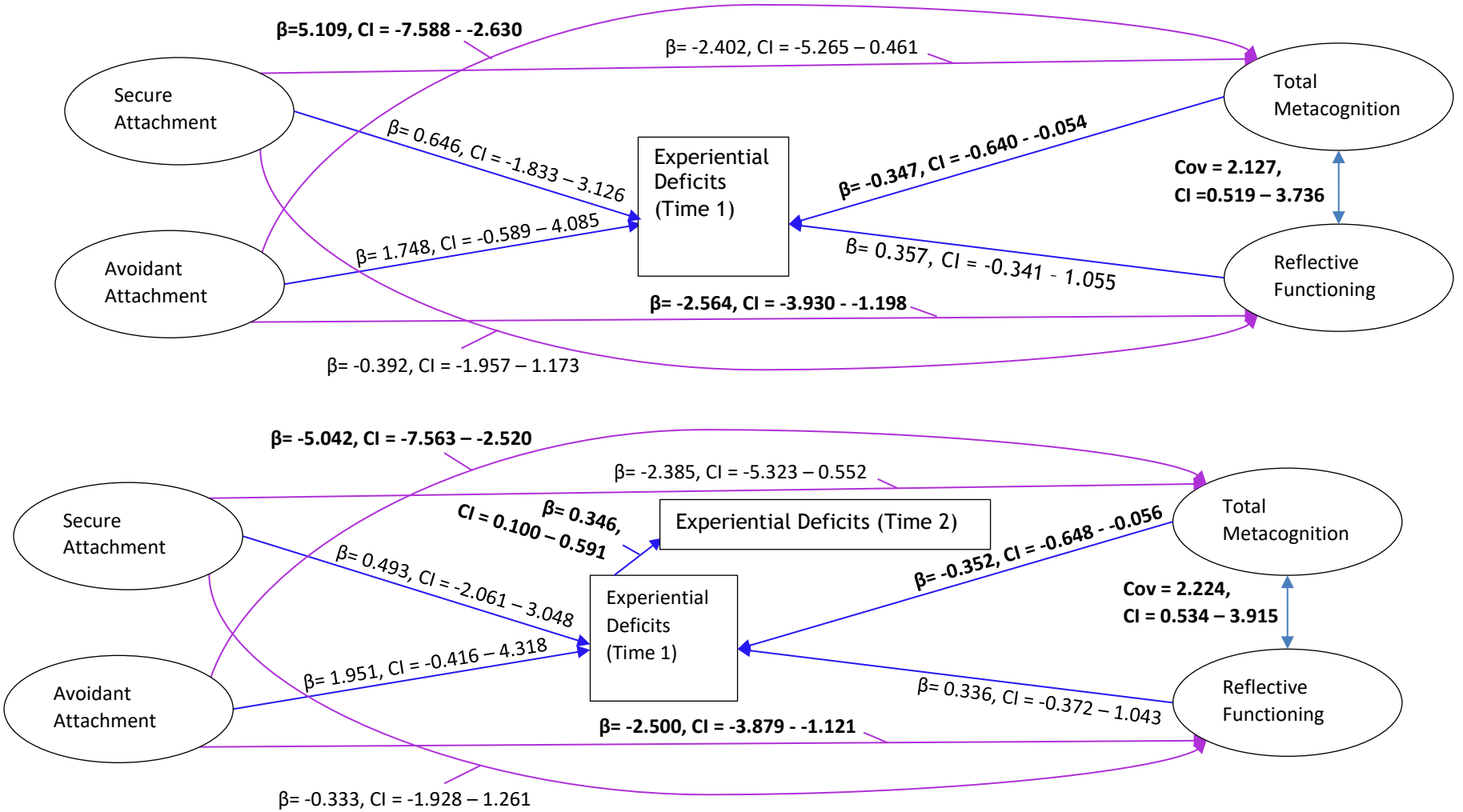
Cov: Covariance; **CI:** Confidence Interval, **bold values indicate statistical significance**

Figure 5.4: Path models exploring attachment classification, metacognition and mentalisation as related predictors of expressive deficits:



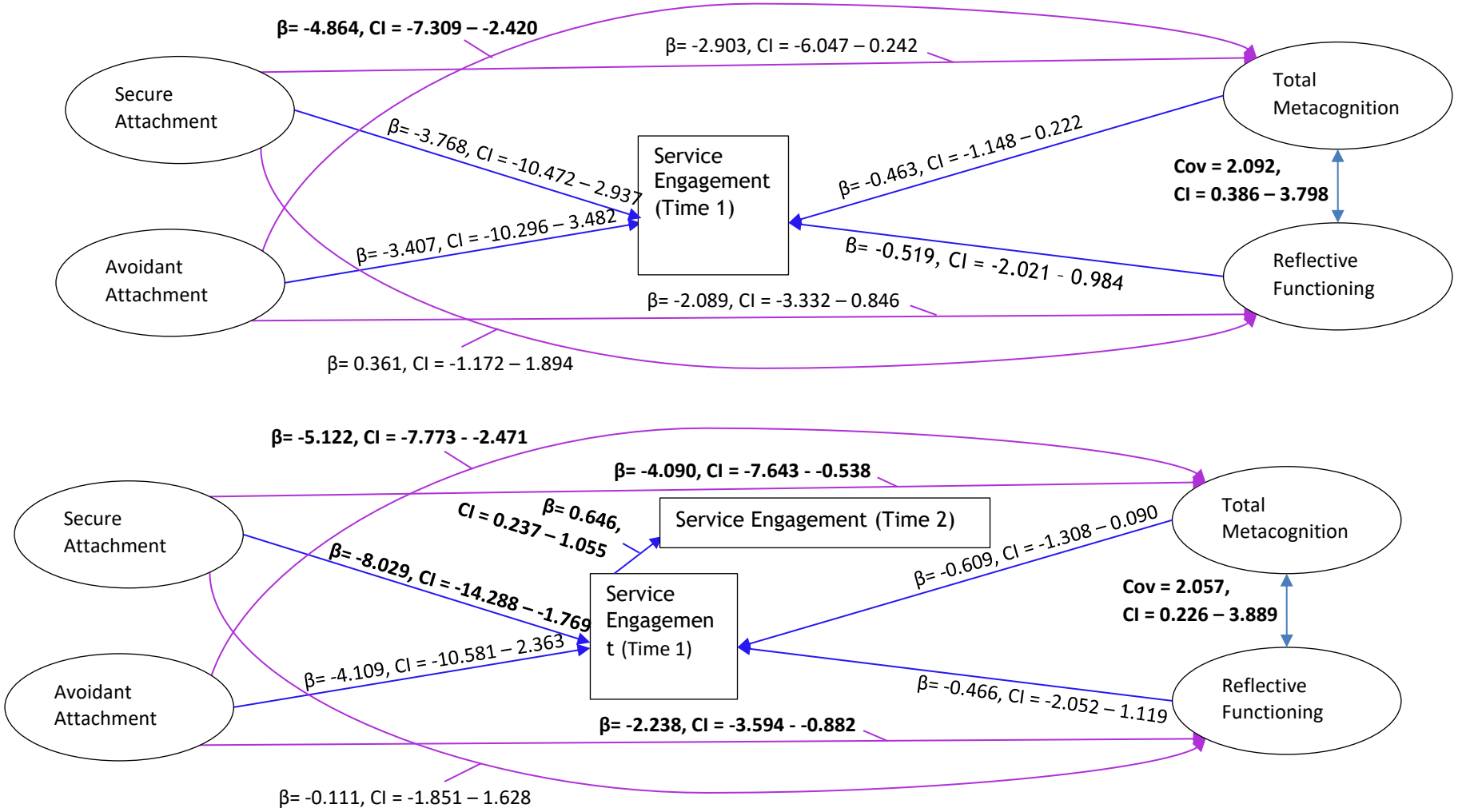
Cov: Covariance; **CI:** Confidence Interval, **bold values indicate statistical significance**

Figure 5.5: Path models exploring attachment classification, metacognition and mentalisation as related predictors of experiential deficits:



Cov: Covariance; **CI:** Confidence Interval, **bold values indicate statistical significance**

Figure 5.6: Path models exploring attachment classification, metacognition and mentalisation as related predictors of service engagement:



Cov: Covariance; **CI:** Confidence Interval, **bold values indicate statistical significance**

Across all models, there was a significant covariance between reflective functioning and total metacognition (2.057 – 2.224) with a slightly higher relationship demonstrated in negative symptom models versus service engagement models. Avoidant attachment (in comparison to secure autonomous attachment) was also related to reflective functioning across all models except service engagement at time one. Beta coefficients were greater for all negative symptom relationships at time one versus models including negative symptoms at time two (β= -2.092 versus -2.071). Avoidant attachment (in comparison to secure autonomous attachment) was also a significant predictor of total metacognition across all models (with the largest association found in the service engagement model at time two: β= -5.122, 95%I = -7.773 - -2.471). In the path model of service engagement at time two secure attachment also significantly predicted total metacognition (β= -4.090, 95%CI = -7.643 - -0.538). Across all models, the outcome score for the preceding time point predicted all categorisations of negative symptoms and service engagement at time two. Models for service engagement also generally had larger beta-coefficients and also larger confidence intervals. Appendix 21 gives all pairing associations described in version one models and the differences in version two models.

5.5 Discussion

These analyses used an existing dataset to assess relationships between reflective functioning, metacognition and attachment classification and their association with negative symptoms (treated as both summed and subscale scores) and service engagement. Hypothesis one predicted that participants grouped by attachment classifications would differ significantly in levels of negative symptoms, service engagement, metacognition and mentalisation. This was confirmed in regression analysis for total metacognition, self-reflectivity, decentration and reflective functioning only, with individuals with avoidant attachment styles having significantly different levels of metacognition and mentalisation from those with secure attachment. However, the overall models were significant for all associations except service engagement. This suggests that in this sample attachment classification is related to the constructs explored (with the exception of service engagement). The difference between preoccupied and avoidant attachment contributed most to these findings.

Hypothesis two predicted that metacognition and mentalisation would explain variance in negative symptoms and service engagement independent of that of attachment classifications. Against expectations, only two variables were identified as significant predictors of any variables at time one: decentration predicted service engagement and avoidant attachment predicted negative symptoms, and the overall models for these outcomes were not significant. However, overall models were significant for total negative symptoms, expressive deficits and service engagement at time two. This suggests that there are additive effects of total metacognition, mentalisation, attachment and preceding outcome scores which explain variance in these outcomes at 12 months. However, metacognition, mentalisation or attachment classification were not significant independent predictors, and only baseline scores significantly predicted outcome score at 12 months.

When metacognition was divided into specific subdomain scores, understanding others' minds emerged as a significant predictor of expressive deficits, and decentration emerged as a significant predictor of all classifications of negative symptoms. No metacognitive subdomains emerged as significant predictors of service engagement. Stepwise regression for models with metacognition treated as a total score and as subdomains generally identified variables associated with the greatest variance in negative symptoms and service engagement similar to those identified in simple and multiple regression analyses, except service engagement where decentration emerged as the most influential predictor. However, these findings should be interpreted with caution as the regression models entering only the predictors identified as most influential were non-significant. This could be because the analyses was still underpowered to detect small effects, or alternatively variance in negative symptoms cannot be reliably explained by these factors alone.

Path analysis allowed exploration of theoretical links between attachment classification, mentalisation, metacognition and negative symptoms and service engagement. In hypothesis three it was anticipated that path analysis would demonstrate a significant path between attachment classification and negative symptoms dependant on levels of metacognition and mentalisation. Only models in which attachment classification also predicted metacognition showed adequate fit statistics, and for classifications of negative symptoms only, not

service engagement. Attachment could therefore plausibly have some associative (or possibly top-down influence) on mentalisation and metacognition, suggesting a developmental perspective on mentalisation more generally might be applicable. This is consistent with other theoretical accounts (Ridenour et al., 2019). Overall, findings that avoidant attachment was predictive of all classifications of negative symptoms at time one, and total negative symptoms and expressive deficits at time two. Metacognition was predictive of experiential deficits only. However, these results should be evaluated in novel data given their exploratory nature and the increased likelihood of type I error (i.e. a false positive).

While inconsistent, these findings give some evidence to support the role of avoidant attachment and components of metacognition more focused on understanding external factors (i.e. others' minds and the world more generally, as in decentration) in predicting negative symptoms. Conversely, secure and preoccupied attachment, and components of metacognition with an internal focus (i.e. understanding oneself and one's own psychological challenges) were not associated with negative symptoms in this study. These findings are generally consistent with studies showing large associations between negative symptoms and metacognition more generally (McLeod et al., 2014) and avoidant attachment is posited to be associated with deactivation of affective and reflective capacities, which are consistent with negative symptom presentations (Gumley et al., 2014b). Some research suggests that negative symptoms arise in response to threat perceived in response to intense emotional states as a safety mechanism (Beck & Rector, 2005) which could explain this finding. The connection between these constructs and service engagement appeared less certain.

Given that a persistent relationship between reflective functioning and attachment, and attachment and negative symptoms and service engagement was observed across studies, it is surprising that reflective functioning was not significantly associated with either of these variables in multiple regression or path analysis. This is perhaps less likely to be a measurement variance issue as greater variance in reflective functioning scores were observed than in metacognition scores observed (Reflective functioning SD= 2.02 of a score range 0-9 versus SD = 3.9 in metacognition scores with a score range 0-28). However,

this could have been confirmed by calculating normed scores for metacognition and mentalisation. The relationship between metacognition and mentalisation was also lower than might be expected (r= 0.54). This suggests that while these constructs might be similar the unexplained variance may be due to metacognition and mentalisation capturing slightly different capacities which are not equally related to negative symptoms.

It is worth noting that both measures of metacognition and mentalisation are likely to represent these constructs at one moment in time when they fluctuate in the moment and in response to different relationships (Ridenour et al., 2019). As such, perhaps the focus on the attachment system in the AAI impacted reflective functioning observed in the study versus if other relationships had been explored. However, if avoidant attachment presents difficulties engaging in reflection on attachment experiences (or inhibition of this as a safety-mechanism), we might expect this to be correlated with lower reflective function (Gumley, 2011) however this was not observed in the current analysis. The possible reasons for non-significant associations with reflective functioning is therefore unclear and requires further exploration.

Additionally, there were unequal distribution of attachment classifications across the sample, with avoidant attachment classification comprising 48.15% of the sample, versus 31.48% and 20.37% of participants represented by secure and preoccupied attachment respectively. Perhaps different relationships would be observed if a greater proportion of insecure attachment was observed. More generally, previous studies have found associations between insecure attachment and negative symptoms, although using different measures (Gumley et al., 2014c). Finally, like other samples in this thesis, negative symptom scores were relatively low and severe negative symptoms were under-represented in the sample. Given that assumption checks suggest that the data was non-normally distributed and potentially non-linear, even after log-transformation, different associations might have been observed had the sample included a greater proportion of participants with severe negative symptoms, or perhaps older participants with long-standing experiences of psychosis (current sample mean age 24.64$\pm$7.08).

These findings, if upheld, have several clinical implications. First, it might be important to focus on threat-oriented development of negative symptoms for some subpopulations of individuals with psychosis. Few studies have investigated this, however one important study demonstrated no evidence for this effect, and instead that safety behaviours were associated with lower negative symptoms (Freeman et al., 2007). However, perhaps research which subtyped individuals dependent on primary and secondary negative symptoms might find different results. Metacognitive therapies, aimed at developing understanding of others mental states, and actions of others as unrelated to the self, such as Metacognitive and Reflective Insight Therapy (Lysaker et al., 2020a; van Donkersgoed et al., 2016) or Metacognition-Oriented Social Skills Training (Inchausti et al., 2017b) could aid with this. Studies already show that some treatments are more effective for experiential versus expressive deficits and vice versa (Grant et al., 2012; Lincoln et al., 2017; Sevy et al., 2020). If path models are upheld, where total negative symptoms show no direct predictors and experiential and expressive deficits are predicted by different constructs (metacognition and avoidant attachment respectively), then alternative treatments might be required. Furthermore, given high associations between attachment style and metacognitive capacity and reflective functioning, further consideration of attachment style in existing therapies targeting these constructs might be required. Gumley et al. (2014b) discusses the impact avoidant attachment might have on service engagement, and it is likely that this could be a predominant factor for consideration in individuals with negative symptoms specifically, given the high association between these constructs.

5.5.1 Strengths and limitations

These analyses were theory-driven, and analytical decisions were transparently reported and sensitivity analyses and assumption checking were used to identify potential factors contributing to findings at each stage. However these analyses are likely to be underpowered as the effect sizes demonstrated were generally small to moderate, and *a priori* power analyses suggested only large effect sizes could be detected as the analyses were limited by the existing sample size. This suggests the need for caution in interpretation due to the increased risk of type II errors, and a requirement for larger samples in future studies. These data have also been analysed in other reported studies and there is therefore a possible increased risk of type I error. Following these issues, further trimming of path

models were not conducted meaning best fit models might not have been identified. Alternatively, better fitting models independent of those assessed with other variables included may fit these data better. There is also little consensus on what represents adequate model fit. While this study explored all commonly reported fit indices as a whole to assess model fit, reference to cut points alone is not recommended, and several of the indices reported were just below or above cut points (i.e. SRMR for expressive deficits at time one).

Given that differences were observed when treating metacognition as separate subdomains, it may have benefitted analyses to explore these subscales in path analyses (albeit with a larger sample due to power constraints). There were also associations observed between the dependent variables, meaning analyses combining these outcomes may also have been more appropriate (although again underpowered). Also, AAI interview data was collected at 6 months meaning the data analysed is non-contemporaneous (i.e. the baseline period for negative symptoms is not contemporaneous with the measurement of metacognition, reflective function and attachment). While there are limitations to this approach, this allowed the maximum variance in negative symptoms to be observed (as opposed to use of data 6 months apart), and these constructs have been shown to be relatively stable in other studies (Buchanan, 2007; Buck & Lysaker, 2013). However, this may also explain why negative symptom models at baseline months were non-significant overall.

Finally, because multiple regression cannot accommodate nominal variables with multiple levels, dummy variables were used to represent different attachment classifications. This may somewhat cloud interpretation as all findings must be construed in reference to the first category (secure attachment), which may have been easier to interpret had other methods (such as ANCOVA) been viable. Furthermore, through use of dummy coding an additional parameter requires estimation as opposed to if attachment could be treated as one variable, and this may have diluted the power of the analyses.

5.6 Conclusions

Overall, this study suggests complex relationships between metacognition, mentalisation, attachment classifications, negative symptoms and service engagement. Regression models indicated that only models with longitudinal

data significantly explained variance in negative symptoms, and only outcome variables at the previous timepoint were significant independent predictors. This could suggest that negative symptom stability is impacted by these variables as opposed to specific levels of negative symptoms, however this may also be an artefact of using non-contemporaneous data. Across analyses, avoidant attachment and total and externally focused subscales of metacognition predicted different categorisations of negative symptoms. Specifically, path models suggest associations between metacognition and experiential deficits and avoidant attachment and expressive deficits, may be strongest indicating potentially distinct clinical needs. Given the inconsistency in findings across analyses, further research is required to investigate whether the associations observed here would be reliably observed in a novel sample and whether other constructs may better explain the relationship between negative symptoms and metacognition.

Chapter 6: Negative symptoms and associations with attachment, metacognition, and emotion regulation

6.1 Abstract

Introduction Studies have demonstrated that negative symptoms are inversely related to metacognition; the capacity to make sense of self-experience and relationships with others. However, the specificity of the link between these two constructs and how these variables interact with related developmental capacities, such as the attachment system and associated emotion regulation strategies, is less clear. This study aims to explore these relationships in two novel archival samples.

Methods This study compared relationships between metacognition, emotion regulation and attachment classifications with levels of negative symptoms. The data were coded for metacognition scores and used in two regression analyses each using a different measure of negative symptoms (the PANSS and CAINS). Post-hoc comparisons, stepwise regression procedures and exploratory path analyses were also used to examine these associations.

Results The overall models exploring the relationship between negative symptoms and attachment classification, metacognition and service engagement were only significant in one of the two datasets which contained a high proportion of missingness and was potentially related to model overfitting. However, higher levels of metacognition (treated as a total score and subscales), secure attachment classification, increased reappraisal and support seeking and reduced expressive suppression strategies emerged as individual predictors of negative symptoms across regression and path models. Correlation and stepwise models generally affirmed these findings.

Discussion The findings, although underpowered, replicate patterns in other existing data which suggest that negative symptoms are associated with attachment and emotion regulation strategies that seek to avoid or minimise emotional responses to distress. Low metacognitive ability may impact on the ability to utilise interpersonal affective strategies in response to reflection on

one's own needs. Further research is required to examine these relationships in a sample with severe negative symptoms.

6.2 Introduction

Chapter five demonstrates that the relationship between metacognition, mentalisation, attachment classifications and negative symptoms and service engagement is not clear. Associations were inconsistent across analyses and there were important methodological implications from the findings. The data presented in Chapter Five raise the possibility that avoidant attachment and metacognitive deficits are important variables in the development and maintenance of negative symptoms over time. These data, in addition to findings from chapter three and four suggest that the associations between metacognition and negative symptoms might have theoretical implications for developing effective treatments, but needs to be considered in light of developmental capacities. Further research to increase understanding of the association between negative symptoms and metacognition will perhaps also address questions raised throughout this thesis around what level of granularity or subgrouping is required to fully understand the relationship between these constructs. Additionally, ability to adopt flexible and collaborative emotion regulation strategies (i.e. reappraisal and support seeking) can be conceptualised as related to metacognitive abilities (Schwannauer, 2013) and might predict levels of negative symptoms. This chapter therefore describes the rationale for, and presents the results of, a study exploring the links between attachment classification, metacognition and emotion regulation and negative symptoms.

6.2.1 Methodological incentives for conducting a replication study

Analyses presented in Chapter 5 were exploratory and results were mixed with wide confidence intervals. This raises the likelihood that the observed patterns might not generalise to all individuals with negative symptoms, and as analyses were underpowered, several moderate and small effects which might have been present in the data may not have been detected. This is an issue across psychology and other areas of scientific research, where associations between constructs have not been replicated, leading to disputes about their certainty

(Wiggins & Chrisopherson, 2019). Investigating associations between negative symptoms and metacognition in novel data helps identify whether these findings might generalise to other individuals experiencing similar difficulties. Therefore this chapter utilises two novel samples (Thomson et al., 2019; henceforth known as Dataset I; Thomson, 2019; henceforth known as Dataset II) to explore whether relationships between constructs explored in the previous chapter are reliable, and whether additional variables such as emotion regulation can better explain variance in negative symptoms.

One possible way to test the reliability of previous associations is to conduct a direct replication study. Tackett et al. (2019) outline several barriers to direct replication in clinical psychology, including difficulties recruiting adequately sized or similar samples, evolving methodology and metrics used to understand relevance of findings. Each of these will be discussed in turn.

6.2.1.1 Accounting for sample differences

Negative symptoms are not experienced by every individual with psychosis, and while some negative symptoms may be especially prevalent (such as amotivation; see Sauve et al., 2019), some studies show negative symptoms being observed in only 40% of people with a schizophrenia diagnosis (Patel et al., 2015). Previous research shows that small and moderate effect sizes are commonly observed in the relationship between negative symptoms and metacognition (see Chapter 2 and 3). Furthermore, recruitment of people with negative symptoms into scientific studies can be limited based on levels of amotivation, or severe symptoms more generally (Roberts et al., 2006). The data utilised in this chapter has been subject to similar recruitment efforts and difficulties as other studies, and is unlikely to contain an entirely equivalent sample. However, they are likely to be of benefit as repeated findings suggesting an association between negative symptoms and metacognition might provide evidence to support larger studies in the future.

Furthermore, sample differences might be beneficial, Chapter 5 utilised data from participants with a mix or first- and multiple- episode experiences of psychosis. Studies suggest that experiences of negative symptoms might be associated with different mechanisms in persons with longer experiences of illness (Chang et al., 2019b; Gee et al., 2016; Stiekema et al., 2018a), and may

require different types of treatment. Furthermore, examining possible treatment mechanisms in persons with long-standing experiences of psychosis can be confounded by the differences longer periods of illness might create on social networks, medication use and effectiveness, and symptom severity (Chang et al., 2011; Fervaha et al., 2014a; Stiekema et al., 2016). As these data utilised here contain first episode psychosis samples, different associations between the constructs of interest might be identified which would further understanding of the impact of persistent negative symptoms.

6.2.1.2 Use of alternative variables

Similarly, direct replication involves using the same methods as the original study, however, in addition to data availability issues in secondary analyses, there are often evolving arguments as psychological discourse emerges which might indicate changes in best practise. This is relevant to the assessment of negative symptoms in that the most used gold standard measures of negative symptoms (the Positive and Negative Syndrome Scale (PANSS; used in the original analyses discussed here) and the Scale for the Assessment of Negative Symptoms (SANS)) have been criticised (Marder & Galderisi, 2017). They fail to encapsulate subjective experience; an important contributor to understanding motivation and anticipatory affect which are often not consistent with behaviour (Strauss et al., 2012). They also include items that are more consistently regarded as indicators of disorganisation (Marder & Galderisi, 2017; Shafer & Dazzi, 2019). Furthermore, with the PANSS specifically, there is little consensus on which factor structure, incorporating which items, is the most accurate, and there is huge variability in how the PANSS is employed across studies and there is an associated lack of transparency in reporting (Opler et al., 2017).

In contrast, newer measures of negative symptoms, while also showing convergent validity with these gold standard assessments (the Brief Negative Symptoms Scale (BNSS), Strauss et al., 2012; and the Clinical Assessment Interview for Negative Symptoms (CAINS), Kring et al., 2013) are also able to assess domains of negative symptoms with due regard to differences between internal experiences and behaviour. Both measures demonstrate good psychometric properties and a strong association with functioning and are considered state of the art measures of negative symptoms (Marder & Galderisi, 2017; Strauss & Gold, 2016). One of the datasets utilised in this study Therefore,

rather than direct replication, incorporation of novel measures might also be appropriate in this context.

6.2.2 Exploring the role of emotion regulation

The previous study in Chapter 5 found no significant relationship between reflective function and negative symptoms despite this being hypothesised. It would be interesting to therefore explore other variables that could also explain more of the variance in negative symptoms, alongside attachment and metacognition. Negative symptoms are often associated with an altered experience of emotion in response to potentially rewarding stimuli (Mote & Fulford, 2020). Affect regulation deficits are an additional potential mechanism which might be implicated in the development of experiential deficits (Strauss et al., 2018). However, the ability of emotion regulation difficulties to explain variance in negative symptoms is not as commonly investigated as the relationship with positive symptoms (Liu et al., 2020).

Of evidence exploring this, researchers have identified an association between attachment styles, emotion regulation and symptoms of psychosis (Ascone et al., 2020; Thomson, 2019), and between attachment and emotion regulation (Owens et al., 2013). While the connections between metacognitive measures and emotion regulation are less clear (Bonfils et al., 2018), and overall less commonly explored, there is theoretical justification (Gumley & Schwannauer, 2006; Harder & Folke, 2012) and preliminary evidence (Thomson, 2019) to suggest that emotion regulation strategies are selected as part of a metacognitive process interpreting self-experience and relationships with others. It is therefore necessary to explore whether emotion regulation explains additional variance in the relationship between attachment, metacognition and mentalisation, and negative symptoms.

6.2.3 Study aims

Given these issues discussed, this chapter presents data examining the relationships between negative symptoms, metacognition, attachment classifications and emotion regulation in two novel archival samples. The Thomson et al. (2019) data (Dataset I) will be used to examine these relationships using the PANSS to measure negative symptoms, and the Thomson

(2019) data (Dataset II) will be used to examine if these findings are reliable when using an alternative measure of negative symptoms (the CAINS). This will further current understanding of the relationship between attachment classification, metacognition and negative symptoms and explore the additional role of emotion regulation in explaining variance between these constructs. All hypotheses (outlined below) will be explored in a range of ways including linear and multiple regression and path analysis.

Hypotheses

1. Variation in negative symptom scores will be predicted by attachment classification, emotion regulation and metacognition, whereby secure attachment, reappraisal and support seeking emotion regulation strategies, and higher levels of metacognition will predict lower levels of negative symptoms. *It is also hypothesised that higher levels of expressive suppression will be associated with higher levels of negative symptoms*.
2. Standardised scores of negative symptoms combining both datasets will be predicted by attachment classification, emotion regulation, metacognition scores, whereby secure attachment, reappraisal and support seeking emotion regulation strategies, and higher levels of metacognition will predict lower levels of negative symptoms.

6.3 Methods

6.3.1 Protocol

The study aims, hypotheses and analyses methods were pre-registered on the open science framework (McGuire et al., 2021) and can be accessed here: https://osf.io/6ys82.

6.3.2 Design

This represents a cross-sectional analysis of existing data (Thomson, 2019; Thomson et al., 2019), both acquired from research projects carried out in NHS Lothian sponsored by Edinburgh University.

6.3.3 Participants

6.3.3.1 Dataset I

This dataset included young people aged 13 to 18 years referred to the Early Psychosis Support Service for a first episode or ultra high-risk mental state for psychosis between 2005 and 2017. Individuals included in this research participated in data collection on clinical measures during time in the service where they received early intervention services including psychological input, occupational therapy, and treatment with anti-psychotic medication. Overall, 141 individuals contributed to the cohort data over this period (Thomson et al., 2019).

6.3.3.2 Dataset II

These participants were recruited from an existing research study and from NHS services (mental health clinics and Child And Adolescent Mental Health specialist tier services) and third sector organisations in Edinburgh aimed at supporting vulnerable individuals. Recruitment took place between July 2015 and March 2018 and included adults aged between 16 and 36, who were identified through professionals involved in their care and/or treatment (i.e. support workers, key workers, or qualified clinicians and registered medical officers). 52 participants were included in the final analyses with a mix of diagnostic information given including experiences of psychosis and mood difficulties.

6.3.4 Measures

The measures captured across these data and how they are employed in this study are summarised below:

6.3.4.1 Psychopathology

Dataset I

The PANSS (Positive and Negative Syndrome Scale; PANSS Kay et al., 1987) was used to measure negative symptoms in Dataset I. It was completed at entry to the service and at 12 months with information from clinical interviews and staff reports and clinical case notes. Scores were analysed using the Lancon et al. (1998) factor structure but for the purposes of this study negative symptom data

will be recalculated using the van der Gaag et al. (2006) factor structure to allow comparison with chapter 5, which scores 9 items (minus the score on item P2) with a possible score range of 2-62. Following the approach taken by McGuire et al. (in prep), the Khan et al. (2017) sub-factor structure will also be used to compare experiential (including emotional withdrawal, passive/apathetic social withdrawal and active avoidance) and expressive (including blunted affect, poor rapport, lack of spontaneity and motor retardation) deficits of negative symptoms a co-primary outcome.

Dataset II

The CAINS (Clinical Assessment Interview for Negative Symptoms; Kring et al., 2013) was used to collect negative symptom data in Dataset II (Thomson et al., 2019). While likely to demonstrate convergent validity with the PANSS negative symptoms subscale, the CAINS is also arguably a more comprehensive measure of the subjective elements of negative symptom experience (Marder & Galderisi, 2017). The CAINS examines motivation and pleasure (9 items) and expression (4 items) separately via interview, with each item scored from 0-4 and higher scores indicating a higher level of impairment. This leads to a possible score range of 0-36 for motivation and pleasure deficits and 0-16 for expressive deficits. These and the total CAINS scores will be used as co-primary outcomes for this dataset.

6.3.4.2 Service engagement

The Service Engagement Scale (SES; Tait et al., 2002) is a 14-item scale measuring four components of overall service engagement: availability, collaboration, help-seeking and treatment adherence. It was completed by clinicians in the original study and is rated between -6 and 18, where higher scores indicate greater service engagement. In addition to baseline data, SES was also captured at 6 and 12 months of service use in Dataset I.

6.3.4.3 Adult attachment

The Adult Attachment Interview (AAI; George et al., 1996; Hesse, 2008) is a 20 question semi-structured narrative interview which asks individuals to recount experiences pertinent to their attachment relationships in childhood. This was

collected across both datasets. For the purposes of this study, several coding systems (described below) were applied to these transcripts.

AAI category coding

The AAI was coded by trained and reliable raters who allocate individuals to one of the categories specified above, organised (secure, avoidant or pre-occupied), or disorganised (unresolved). The 2-category coding of the AAI compares individuals based on whether they are categorised as insecure or secure. Given that previous samples were unbalanced in relation to the 3-category AAI coding (comprising secure, avoidant and preoccupied categories; see chapter 5), it was agreed that the two-category secure and insecure (comprising avoidant and preoccupied) ratings of attachment would be compared in analyses instead. Categorisation is derived based on rating each interview on a series of nine-point scales classifying childhood experiences of receiving parenting and current state of mind regarding attachment including overall interview coherence. Secure attachment, also categorised as “freely autonomous”, is where attachment experiences are regarded as influential and individuals can describe both positive and painful aspects of these, and also appear relatively independent.

Alternatively, interviews can be classified as either of the “insecure” attachment classifications. Avoidant attachment is categorised by denial, minimisation or shutting down in response to discussing attachment experiences and also appear relatively independent. Preoccupied individuals appear confused in relation to attachment experiences and dialogue may show conflicted feelings, intense feelings of trauma and loss and reflections are prolonged, vague, and uncritical. Both are characterised by difficulty in attachment relationships and difficulty receiving comfort from caregivers. Finally, where individuals show two or more indications of contradictory attachment strategies they are classified as having an unresolved attachment categorisation, often seen in response to experiences of trauma and loss. Unresolved is considered a disorganised attachment classification and this classification will not be considered in the current analysis.

Metacognitive functioning

The MAS-A (Metacognition Assessment Scale – Adapted (Semerari et al., 2003; Lysaker et al., 2005) is a coding framework that can be applied to AAI transcripts

(McLeod et al., 2014) to measure metacognition. It gives four subscale scores and a total score of metacognitive capacity (ranging from 0-28), and similar to Reflective Functioning, higher ratings are awarded where reflections with increasing complexity are demonstrated. The score is derived from four subscales:

- Self-Reflectivity - the ability to form increasingly complex representations of oneself and ones' mental states
- Understanding Others' Minds - the ability to make sense of others and form a complex narrative around others' thoughts and emotions
- Decentration - the ability to understand the world as separate from one's own view of it
- Mastery - the ability to use these representations to make sense of and manage psychological problems.

6.3.4.4 Emotion regulation

Dataset I

The Regulation of Emotions Questionnaire (REQ) is used to examine emotion regulation in adolescents. It has been used to measure the strategies adolescents endorse to manage their emotions, utilising internal and external resources (Phillips & Power, 2007). For the purposes of the four subscales produced will be grouped into two subscales to minimise the impact of additional variables on the power of the analyses. The internal and external scales will be grouped by functionality to give an overall score for functional and dysfunctional emotion regulation techniques. Each item is scored between 1 and 5 with higher scores indicating greater endorsement of using that emotion regulation strategy. The possible score ranges are 11-55 for functional emotion regulation strategies and 10-50 for dysfunctional emotion regulation strategies.

Dataset II

The Emotion Regulation Questionnaire (ERQ) is used to examine emotion regulation in Dataset II (Gross & John, 2003). It is developed from a process

model of emotion regulation where cognitive reappraisal and expressive suppression were identified as common and definable emotion regulation strategies which are also conceptualised in terms of their perceived adaptiveness, similar to the functional and dysfunctional components of the REQ. Indeed expressive suppression has been associated with greater psychopathology (Eftekhari et al., 2009). Across the 10 items, 6 correspond to the reappraisal scale and 4 to the suppression scale, leading to a possible total score of between 6-42 and 4-28 for each subscale respectively, with greater scores indicating greater endorsement of using that emotional regulation strategy.

6.3.5 Procedure

The original researchers, who completed ratings for psychopathology, emotion regulation and attachment measures to be used in the analyses, have already collected all data required. The primary researcher (NM) recalculated PANSS negative symptom data using the van der Gaag et al. (2006) and Khan et al. (2017) factor structures. The data were explored by the primary researcher and checked for completeness, uniform reporting of units for each variable, and that units reported were valid (i.e. no PANSS negative symptom scores higher than the total possible score). In both datasets summed scores were computed where this was not present but complete raw data was available. The primary researcher (N.M) also coded AAI transcripts for metacognition using the MAS-A with a random proportion checked for calibration and reliability with a second rater (H.M). Both raters completed MAS-A training and were calibrated to 1 point or less within gold-standard ratings on training transcripts.

To ensure calibration between MAS-A raters, it was agreed 3 randomly selected transcripts would be blind-rated, in rounds, until an agreed calibration threshold was met of no more than 1 point difference per subscale for a round of transcripts. This was halted following two calibration rounds due to time constraints. The largest difference across rater's scores was 2 points. The only exception was mastery where the slightly larger 2.5 score deviation was attributed to mastery being the only scale rated which is treated non-hierarchically, meaning preceding categories do not also need to be demonstrated, creating less anchors for cohesion amongst raters. Across both

rounds of ratings however most discrepancies corresponded to 0.5 or less points difference in ratings.

It was therefore agreed that full rating of all MAS-A transcripts would take place with 2 randomly selected transcripts rated by the second rater (H.M.) for every twenty transcripts rated by the primary researcher (N.M). The largest discrepancy across ratings was 2.5 points, however the majority of discrepancies corresponded to 0.5 or less points difference in ratings. A weighted Cohen's Kappa was calculated for all ratings to assess overall inter-rater reliability and this was an acceptable level (K = 0.81). A complete breakdown of calibration between MAS-A ratings can be found in Appendix 22.

6.3.6 Ethical considerations

The University of Glasgow Ethics committee provided ethical approval for this research (application number: 200200132, following confirmation from NHS Lothian Research Ethics Service and University of Edinburgh that their ethical approval was not required). All data evaluated was fully anonymised and processed in line with the ethical requirements of the original study. The Glasgow University Data Management Service were also contacted to ensure that this study operated in accordance with existing policy. See Appendix 23 for full details of these approvals.

6.3.7 Statistical analyses

All analyses were conducted in R Version 4.1.0 (code available at https://osf.io/6ys82/).

6.3.7.1 Primary analyses

Correlations and scatterplots were examined coding for attachment classification (secure versus insecure) to assess for linearity in relationships between metacognition, emotion regulation and negative symptoms, separated by dataset. At each stage of analysis multivariate normality was also assessed through a histogram of residual values, which was compared to the results of a Q-Q plot and Shapiro-Wilk test for normality. Variance Inflation Factors and scatterplots between all variables were inspected to assess multicollinearity.

Finally, homoscedasticity was tested using a plot of residuals versus fitted values.

All analyses were conducted in reference to the general linear model. Hypotheses one was tested through various methods. First, dummy variable coding was used to examine the impact of attachment classification on negative symptoms, metacognition and emotion regulation. ANOVA tables and post hoc pairwise comparison tests allowed examination of the differences between attachment groups. Hypotheses one was also tested via multiple regression as the role of each variable in predicting negative symptoms is of equal interest. Regressions included all variables for each dataset separately, to examine the variance explained by each predictor on levels of negative symptoms. A secondary analyses including interaction effects was included to investigate the impact of interactions between variables on negative symptom levels. Stepwise regression analysis additionally assessed which variables were likely to explain the most variance in the models.

6.3.7.2 Exploratory analyses

Hypothesis one was also explored with path analyses (separately for each dataset) used to model causal relationships between the exogenous variables (AAI classifications of secure and insecure attachment from dummy variable coding, total metacognition scores (measured with the MAS-A), and emotion regulation scores), and the endogenous variable (negative symptoms). Goodness of fit was determined by Chi-Square, comparative fit index (CFI), Root Mean Square Error of Approximation (RMSEA) and Akaike Information Criterion (AIC) and Standardised Root Mean Square Residual (SRMR) statistics, where fit is assessed in line with guidelines described by Hooper et al. (2007). As a secondary analysis, MAS-A subscales were inserted in the same analyses, replacing total metacognition. The Lavaan package in R version 4.1.0 was used.

Hypothesis two was tested in an exploratory analysis by standardising negative symptom scores across datasets. Negative symptom and emotion regulation data were transformed into z-scores allowing both datasets to be compared and thus combined. This allowed a larger sample to explore the same analyses and determine whether the findings related to hypothesis one could be replicated in a larger sample. However, given the potential confounds in the data since they

came from two independent samples this was not treated as the primary analysis.

Power calculation

We conducted an *a priori* power calculation for the primary models (linear multiple regression). To detect a large effect size with an alpha level of 0.05 and 80% power, a sample size of 40 participants is required. To detect a medium effect size with the sample alpha and power parameters, a sample size of 85 would be required.

6.4 Results

6.4.1 Descriptive statistics

Tables 6.1 and 6.2 summarise the characteristics of Dataset I and II respectively for all available data. Although Dataset I was larger, more participants lacked complete data for analysis purposes, and Dataset II had less missing data overall. For Dataset I, only 14 participants had complete data which could be included in multiple regression analysis. Excluding emotion regulation, 24 participants had complete data. For Dataset II 29 participants had complete data which contributed to the primary regression models. A further two individuals had full data for expressive deficit models only. When grouped by attachment style both datasets were largely unbalanced and preoccupied attachment was the categorisation fewest participants met. This strengthens the justification for combining insecure attachment groups. Both a chi square (X^2(2, N=59), 4.438, p= 0.109) and due to low counts, Fisher's exact test (p=0.135) were conducted and showed no significant associations between groups.

Table 6.1: Characteristics of samples – continuous variables

Continuous Variables						
Variable (Dataset I/Dataset II)	**Dataset I (146 participants)**			**Dataset II (54 participants)**		
	Mean	**SD**	**N Missing**	**Mean**	**SD**	**N Missing**
Age	16.12	1.35	2	18.92	2.92	15
Weeks of Untreated Psychosis	40.86	54.95	50	149.5	104.81	50
Self-Reflectivity	3.84	1.66	117	4.44	1.50	22
Understanding Others' Minds	2.81	1.44		3.17	1.18	
Decentration	1.10	0.77		1.34	0.53	
Mastery	3.41	1.11		3.75	0.622	
Total Metacognition	11.17	4.07		12.70	2.87	
Total Negative Symptoms (PANSS/CAINS)	16.84	8.12	54	12.71	9.80	22
Expressive Deficits (PANSS/CAINS)	7.92	4.65	54	2.5	3.77	23
Experiential Deficits (PANSS/CAINS)	7.60	3.65	53	10.03	6.79	23
Functional Emotion Regulation (ERQ Functional/REQ Reappraisal)	16.48	7.66	56	24.87	6.63	16
Dysfunctional Emotion Regulation (ERQ Dysfunctional/REQ Suppression)	12.28	7.23	57	17.13	4.674	16

SD: Standard Deviation

Table 6.2: Characteristics of samples - categorical variables

Variable		**Dataset I**	**Dataset II**	**N Missing**	
				Dataset I	**Dataset II**
Attachment	Secure: Freely Autonomous	6	13	118	23
	Insecure: Avoidant	21	15		
	Insecure: Preoccupied	1	3		
Gender	Female	62	16	1	13
	Male	83	21		
	Transgender (comprising agender, demi-boy, non-binary)	Not collected	4		

Diagnosis					
Dataset I		**Dataset II**		3	17
Schizophrenia	16	Depression	5		
Schizoaffective disorder	1	Anxiety (including social anxiety)	5		
Bipolar disorder	24	Psychosis	3		
Unknown	2	Comorbidities (including anxiety, depression, paranoia, hallucinations and mesophonia)	8		
Psychosis Not Otherwise Specified	79	Attention Deficit Hyperactivity Disorder	1		
Other	1	Obsessive Compulsive Disorder	1		
At risk mental state	20	Eating disorder	2		
		Emotional problems	2		
		Not sure	2		

6.4.2 Correlation analyses

We examined scatterplots of negative symptom data (explored as total, experiential and expressive deficits for the PANSS and the CAINS in datasets I and II respectively) compared with total and subscale scores of metacognition and measures of emotion regulation (ERQ and REQ subscales for datasets I and II respectively). Generally, plots indicated an inverse relationship between negative symptoms and metacognition and both types of emotion regulation strategies. This suggests, that independent of negative symptom and emotion regulation measure used, and independent of dataset, as metacognitive ability increased levels of negative symptoms were lower. Additionally, higher levels of negative symptoms were associated with less use of reappraisal and support seeking and increased use of expressive suppression emotion regulation strategies. A summary of the primary comparisons for each dataset is summarised in Figures 6.1 and 6.2.

However, in correlation analyses only the relationship between experiential deficits and reappraisal emotion regulation strategies were significantly associated with each other ($r(34)= -0.23$, $p=0.042$), alongside significant internal correlations between subscales of metacognition and negative symptoms. A full outline of correlation analyses is provided in Table 6.3 and 6.4. It is however possible that these findings are due to both datasets being significantly underpowered. When using the z-score transformed and combined datasets, further significant correlations emerged. Total negative symptoms was significantly associated with self-reflectivity, understanding others' minds, and reappraisal and support seeking emotion regulation strategies ($r(53)= -0.33$, $p=0.015$, $r(53)= -0.30$, $p=0.028$ and $r(86)= -0.26$, $p=0.017$ respectively). At the subdomain level, expressive deficits were also associated with total metacognition ($r(55)= -0.30$, $p=0.028$) and experiential deficits were associated with reappraisal and support seeking emotion regulation strategies ($r(86)= -0.27$ $p=0.012$).

Figure 6.1: Negative symptoms associations with metacognition across datasets

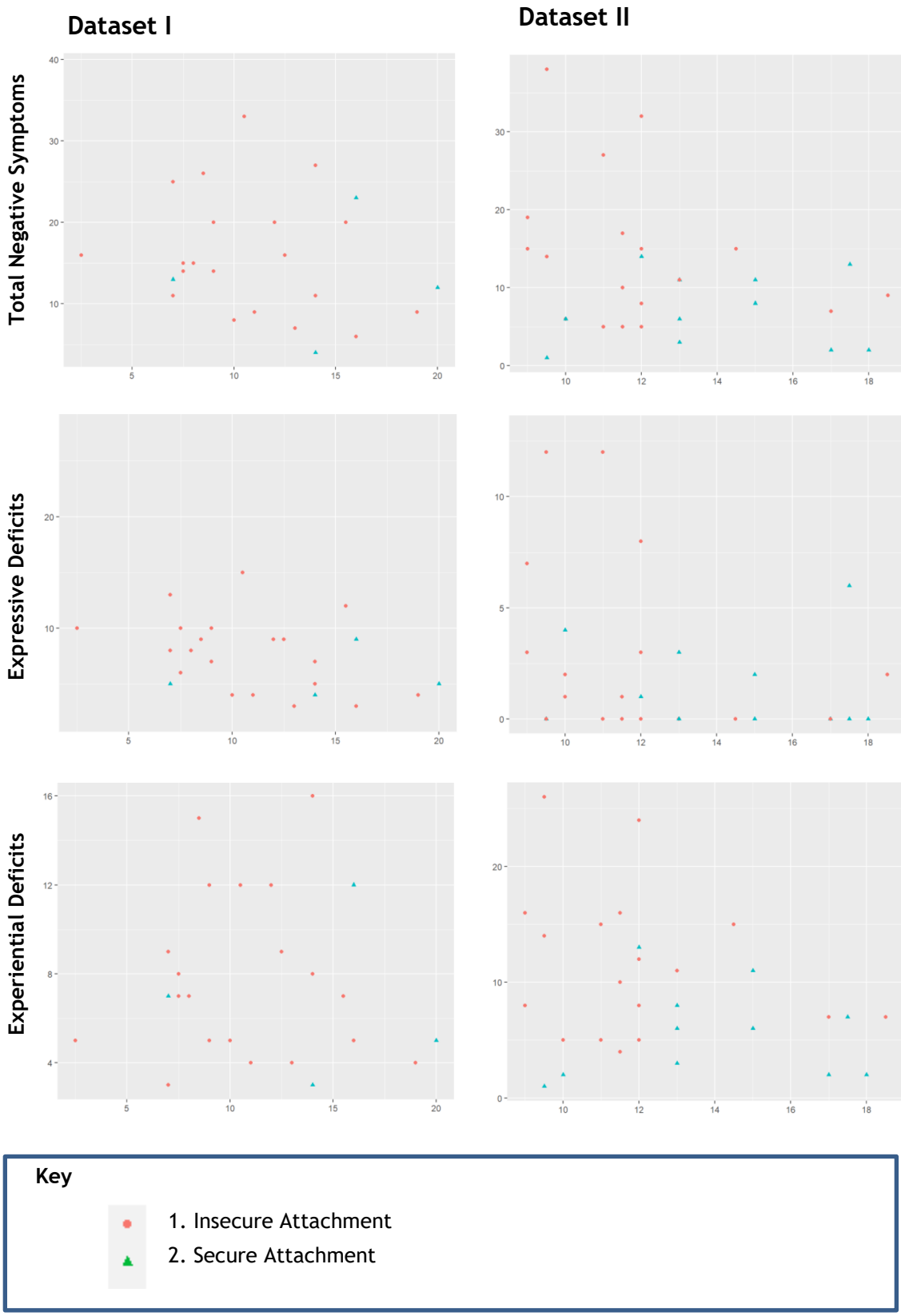


Figure 6.2: Emotion regulation strategies and associations with metacognition across datasets

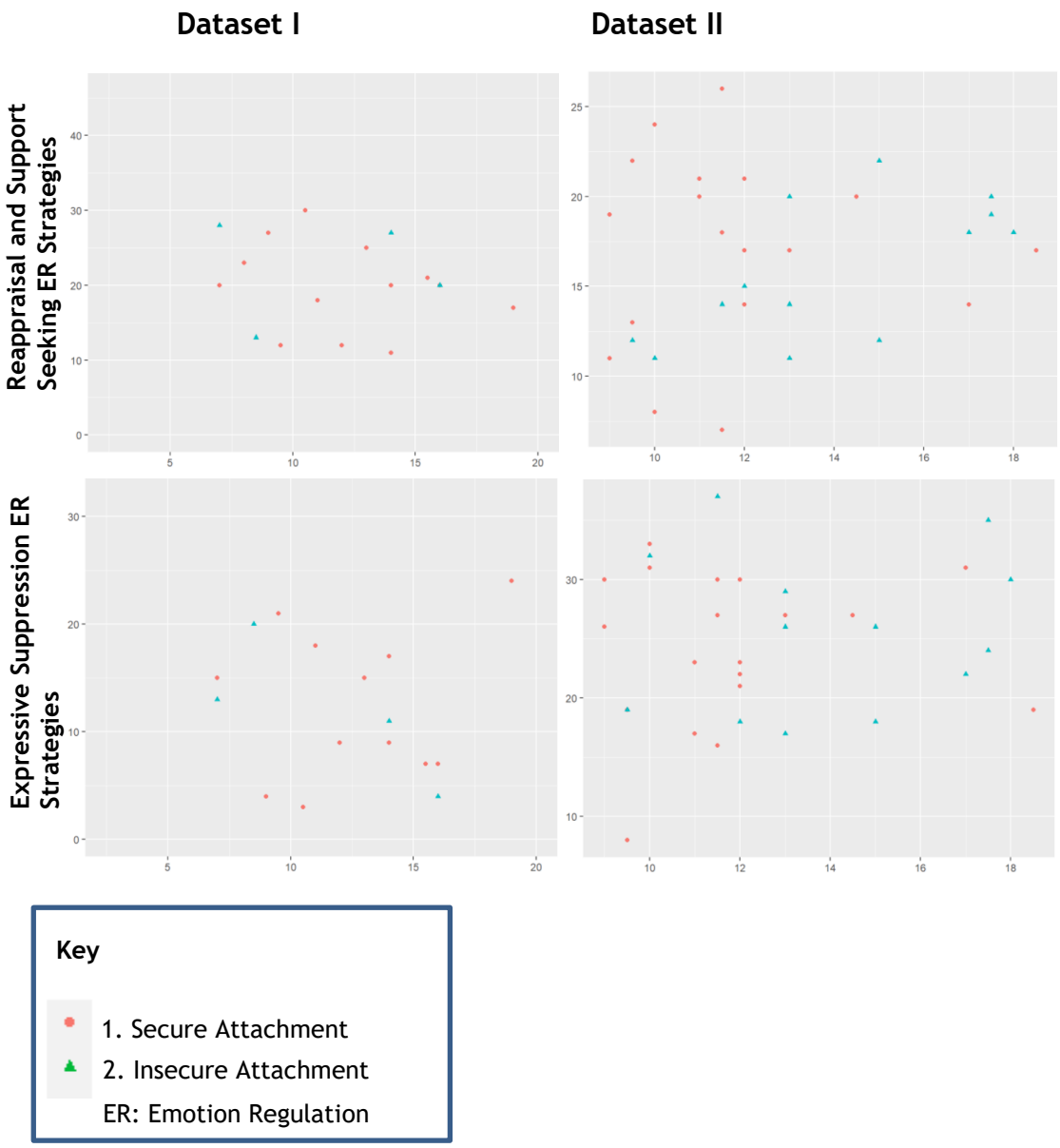


Table 6.3: Correlations between negative symptoms, metacognition and emotion regulation variables in Dataset I

	Expressive Deficits	Reappraisal/Support Seeking ER	Expressive Suppression ER	Total Metacognition	Self-Reflectivity	Understanding Others' Minds	Decentration	Mastery
Total Negative Symptoms		-0.05	-0.46	-0.13	-0.42	-0.37	0.47	0.25
Experiential Deficits	**0.54***	-0.24	-0.44	-0.04	-0.21	-0.23	0.38	0.15
Expressive Deficits		0.11	-0.55	-0.17	-0.46	-0.34	0.33	0.27
Reappraisal/Support Seeking ER Strategies			-0.41	-0.39	-0.20	-0.30	-0.34	-0.36
Expressive Suppression ER Strategies				0.14	0.10	0.01	0.09	0.24
Total Metacognition					**0.75***	**0.84***	**0.68***	**0.68***
Self-Reflectivity						0.66	**0.13***	**0.10**
Understanding Others' Minds							**0.36***	**0.38***
Decentration							0.85	

Table 6.4: Correlations between negative symptoms, metacognition and emotion regulation variables in Dataset II

	Expressive Deficits	Reappraisal/Support Seeking ER Strategies	Expressive Suppression ER Strategies	Total Metacognition	Self-Reflectivity	Understanding Others' Minds	Decentration	Mastery
Total Negative Symptoms		-0.28	0.39	-0.41	-0.38	-0.39	-0.08	-0.03
Experiential Deficits	**0.74***	**-0.27***	0.39	-0.36	-0.33	-0.34	-0.11	0.02
Expressive Deficits		-0.26	0.33	-0.45	-0.42	-0.43	-0.02	-0.13
Reappraisal/Support Seeking ER			-0.48	0.09	0.07	0.15	-0.18	0.16
Expressive Suppression ER				0.13	0.07	0.18	0.39	-0.39
Total Metacognition					**0.90***	**0.86***	**0.46***	**0.06***
Self-Reflectivity						**0.74***	0.25	-0.20
Understanding Others' Minds							0.17	-0.09
Decentration								0.08

ER: Emotion Regulation

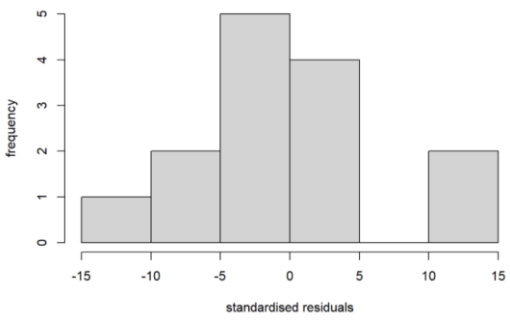
6.4.3 Regression analyses

In regression analyses, both datasets appeared skewed due to limited data contributing to analyses. However, given that Dataset II appeared to have a positive left skew for negative symptoms, indicated non-normality for expressive deficits in particular on Shapiro Wilk test result (W=0.925, p=0.032), and had non-normal distribution of errors indicating heteroscedasticity, Dataset II was log-transformed. See figure 6.3 for visualisations of the skew and residual error issues. When samples were combined, positive left skew was also apparent and all negative symptom categorisations were identified as non-normally distributed (W=0.862-0.940, p>0.001-0.025), therefore this data was also log-transformed.

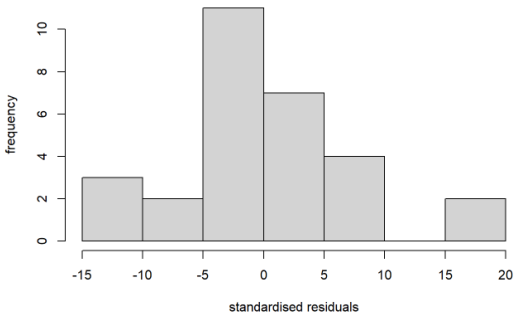
Figure 6.3: Normality of Dataset I and II prior to log-transformation

Histograms

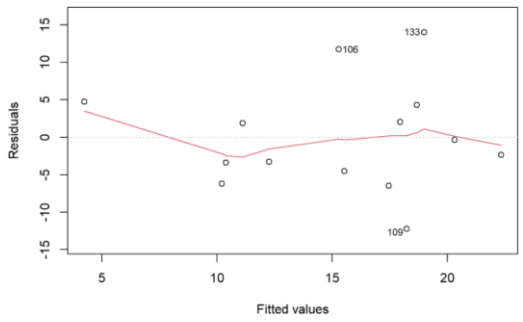
Dataset I

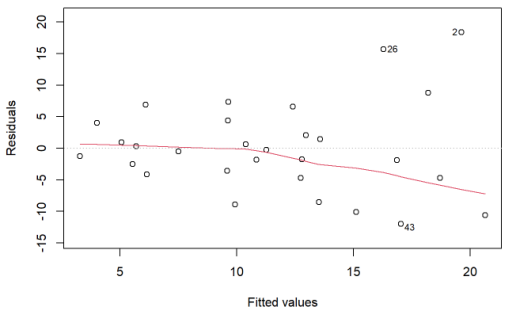


Dataset II:



Residuals versus Fitted Values





6.4.3.1 Dataset I

Of simple regressions exploring relationships between negative symptoms, emotion regulation and metacognition with adult attachment, only self-reflectivity was significantly predicted by attachment (ß=1.562, 95% CI= 0.097 - 3.026, P=0.038), yet self-reflectivity was not a significant predictor in any multiple regression models. Multiple regression models exploring the relationship between negative symptoms, emotion regulation, metacognition and attachment classification in Dataset I were not significant, however, expressive suppression emotion regulation strategies emerged as a significant predictor of experiential deficits (ß= -0.454, 95% CI=-0.886 - -0.022, p=0.042). When the MAS-A was examined by subscales, models appeared likely to have suffered from over-fitting, with overall models explaining a high level of variance in negative symptoms unanticipated by preceding assumption checks (R^2=0.835-0.94, F(6,7)= 4.327-13.42, p=0.047-0.003 for total negative symptoms and experiential deficits, the model for expressive deficits was not significant.

Several predictors did emerge as significant in these models, understanding other's minds, decentration and both types of emotion regulation strategies significantly predicted levels of total negative symptoms, with decentration indicating the largest unit shift in negative symptoms for a one unit change in decentration (ß= 8.870, 95% CI=3.692 - 14.046, p=0.006). This finding had notably wide confidence intervals and is in an unanticipated direction, although consistent with correlation analyses. Decentration was also the largest predictor of experiential deficits (ß= 4.359, 95% CI=0.140 – 8.577, p=0.045). Reappraisal and support seeking emotion regulation strategies were inversely associated with total negative symptoms and experiential deficits (representing a 0.494 and 0.586 unit decrease in experiential and total negative symptoms respectively for every one unit increase in use of this emotion regulation strategy). Expressive suppression was associated with all categorisations of negative symptoms, responsible for between a 0.418 and 0.839 unit decrease in negative symptoms for every one unit increase in use of expressive suppression. These associations can be examined in full in table 6.5 and a breakdown of all regression results can be found in Appendix 24.

To examine whether the effects of low data impacted findings, emotion regulation was removed from analyses to examine associations between metacognition and negative symptoms in a larger proportion of the dataset. Only the overall model for total negative symptoms remained significant (R^2=0.43, F(5,18)= 2.761, p=0.05) with decentration as a significant predictor (ß= -5.314, 95% CI= 0.089 – 10.540, p=0.047). No models containing interaction terms for any variables were significant. It is unclear whether associations between other forms of metacognition with different negative symptoms and associations between negative symptoms and emotion regulation are the result of model over-fitting or whether the underpowered analyses were simply unable to reliably detect these effects in the dataset.

Stepwise regressions were also generally consistent with findings which may also suggest models are saturated. Two models suggested additional variables which had not already emerged as significant in original analyses as top predictors, mastery as a predictor of expressive deficits and understanding others' minds as a significant predictor of experiential deficits. These were significant in analyses only including these and other top predictors in the models. Specifically, mastery was a significant predictor in a model of expressive deficits which also included self-reflectivity, understanding others' minds and expressive suppression (ß=2.169, 95% CI= 0.760 – 3.578, 0.007). Understanding others' minds was also a significant predictor in a model of experiential deficits including decentration and emotion regulation strategies (ß= -2.028, 95% CI= -3.598 – -0.459, p=0.017). It is unclear whether these inconsistencies between stepwise and original regressions are caused by overfitting or whether the significance of these predictors is obscured by underpowered models.

6.4.3.2 Dataset II

Results from Dataset II indicated partial support for study hypotheses, however no models for expressive deficits were significant. Consistent with simple linear regression associations, adult attachment classification predicted significant variance in total negative symptoms and experiential deficits in models exploring the relationship between negative symptoms and total metacognition, adult

attachment and emotion regulation strategies. In the model examining total negative symptoms, avoidant attachment predicted a 0.736 unit increase in negative symptoms versus secure attachment (95% CI= -1.386 - -0.087, p=0.025) although the overall model was not significant. Insecure attachment predicted a 0.865 unit increase in experiential deficits compared to secure attachment (95% CI= -1.443 - -0.287, p=0.005) and the overall model explained 39.2% of the variance in negative symptoms (F(2,24)=3.863, p=0.015). Metacognition and emotion regulation were not significant in these analyses. When metacognition was treated as MAS-A subscales, insecure attachment remained a significant predictor of total and experiential deficits, with slightly larger beta coefficients (β= -1.004 for total negative symptoms and β=-1.182 for experiential deficits). Self-reflectivity also emerged as a significant predictor of experiential deficits (β= 0.348, 95% CI= 0.014 – 0.681, p=0.042) and the overall model retained its significance (R^2=0.552, F(7,21)=3.689, p=0.009). No interaction terms were significant.

Stepwise regression also saw adult attachment classification emerge as the most influential predictor for all models except expressive deficit models. Total metacognition was suggested to be the least influential predictor in total negative symptom and experiential deficit models but removal of this variable did not alter significance of results. When the MAS-A subscale scores were used as predictors, reappraisal emotion regulation strategies also emerged as a top predictor of experiential deficits. Reappraisal was also found to be significant in a model where only the most influential predictors were included (i.e. attachment classification, decentration, self-reflectivity, and reappraisal emotion regulation strategies; β= -0.046, 95% CI= -0.089 – 0.328, p=0.033).

6.4.3.3 Secondary analyses of combined datasets

Given the similarities of measures used, it was pre-determined that both datasets would be transformed to incorporate z-scores for all negative symptoms classified as total negative symptoms, experiential and expressive deficits and for emotion regulation strategies. This allows comparison of these models in a larger dataset and increases the power of the analyses. Interestingly, when regressions were

replicated, associations were consistent with Dataset II only, which makes sense given that Dataset II contributed more participants to the overall sample. No multiple regression model using the combined dataset significantly predicted negative symptoms. However, attachment classification significantly predicted total negative symptoms and experiential deficits, resulting in a 0.605-0.715 unit decrease in total and experiential negative symptoms respectively compared to secure attachment categories in these models.

Only reappraisal and support seeking emotion regulation strategies significantly predicted expressive deficits (ß= -13.443, 95% CI= -26.763 – -0.124, p=0.049) in interaction term models, however confidence intervals were much wider than any other analyses. An interaction between total metacognition and these strategies also emerged as a significant predictor of expressive deficits (ß=1.242, 95% CI= 0.076 – 2.409, p=0.040), however the overall model was non-significant (R^2= 0.686, F(7,6)= 1.868, p=0.232). In comparison to models using Dataset II only, few additional participants would have contributed to these models reported here, as so few participants in Dataset I had emotion regulation data. Therefore, these models were also explored with both emotion regulation variables removed. Results were similarly non-significant overall, however decentration did predict expressive deficits (ß= 1.112, 95% CI= 0.217 – 2.006, p=0.018).

Table 6.5: Significant associations across multiple regression models

Dataset I						
Outcome	**Model**	**Predictor**	**β**	**P Value**	**95%CI Lower**	**95%CI Upper**
Total Negative symptoms	Model 2	Understanding others' minds	-4.713	0.006	-7.502	-1.925
		Decentration	8.870	0.006	3.692	14.046
		Reappraisal and support seeking	-0.586	0.023	-1.056	-0.116
		Expressive Suppression	-0.839	0.002	-1.249	-0.429
Expressive Deficits	Model 2	Expressive Suppression	-0.418	0.015	-0.719	-0.116
Experiential deficits	Model 1	Expressive Suppression	-0.454	0.042	-0.886	-0.022
	Model 2	Decentration	4.359	0.045	0.140	8.577
		Reappraisal and support seeking	-0.494	0.020	-0.878	-0.111
		Expressive Suppression	-0.437	0.019	-0.771	-0.103
Dataset II						
Outcome	**Model**	**Predictor**	**β**	**P Value**	**95%CI Lower**	**95%CI Upper**
Total Negative Symptoms	Model 1	Attachment Classification	-0.736	0.028	-1.386	-0.087
	Model 2	Attachment Classification	-1.004	0.009	-1.734	-0.275
Experiential Deficits	Model 1	Attachment Classification	-0.865	0.005	-1.443	-0.287
	Model 2	Attachment Classification	-1.182	>0.001	-1.789	-0.575
		Self-Reflectivity	0.348	0.042	0.014	0.681
Combined Dataset						
Outcome	**Model**	**Predictor**	**β**	**P Value**	**95%CI Lower**	**95%CI Upper**
Expressive Deficits	Model 3	Reappraisal and Support Seeking	-13.443	0.049	-26.763	-0.124
		Interaction between Total Metacognition and Reappraisal and Support Seeking	1.242	0.040	0.076	2.409

Model 1: attachment classification, metacognition (treated as total score) and emotion regulation

Model 2: attachment classification, metacognition (treated as subdomains) and emotion regulation

Model 3: attachment classification, metacognition (treated as total score) and emotion regulation with interaction terms added

6.4.4 Path analysis

Exploratory path analyses were pre-determined based on theoretically driven models of associations between components of these regression models expected to predict negative symptoms. There is some support for this given that total metacognition, mastery, decentration and self-reflectivity were associated with negative symptoms in at least one simple regression analyses. Three theoretical perspectives were explored in path models:

1. Attachment classification would predict metacognition, and metacognition would predict emotion regulation.

2. Attachment would predict metacognition and metacognition and emotion regulation would only be correlated.

3. Attachment, metacognition and emotion regulation would only be correlated.

As these models were not fully saturated (i.e. did not make predictions about all available components of the model) further constraints were not required and models and fit statistics are presented here. MLR estimation was used as the standard errors provided (Huber-White estimation) and test-statistic (equivalent to the Yuan-Bentler correction) allows assessment of model fit while correcting for data being non-normally distributed. None of the models from either dataset or the combined data demonstrated acceptable model fit, except chi square statistics (see Table 6.6, and Appendix 25 for combined data models). Dataset I models replicated the finding that expressive suppression was inversely associated with levels of negative symptoms, and the finding that less use of reappraisal and support seeking emotion regulation was associated with higher levels of experiential deficits was replicated, but the association with total negative symptoms was not. Across all categorisations of negative symptoms, total metacognition was also associated with reappraisal and support seeking strategies. Models treating the associations between metacognition and attachment as a correlated rather than a predictive relationship displayed better fit statistics (e.g.

AIC, CFI), however the confidence intervals for associations in these models were much wider.

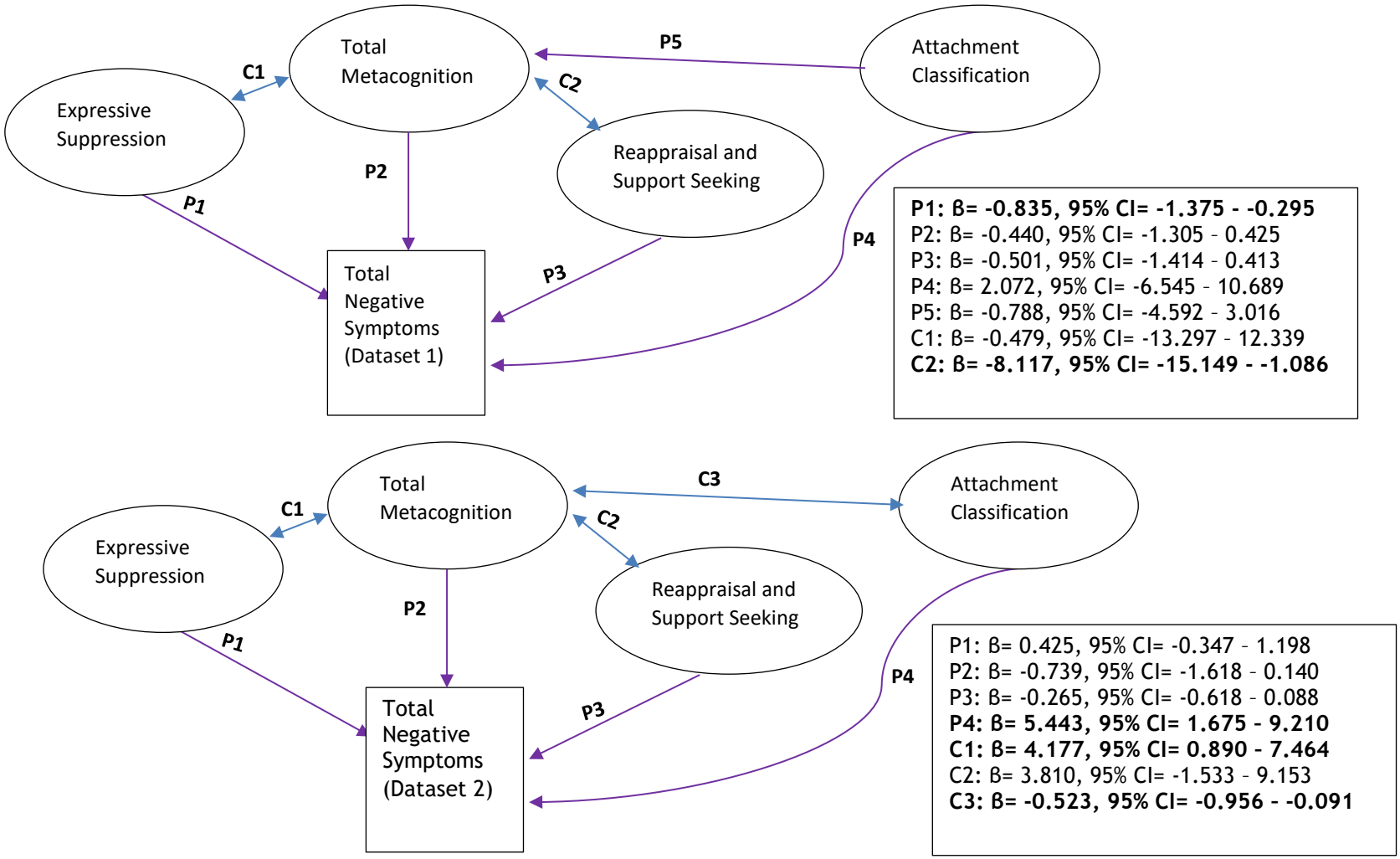
For Dataset II, consistent with the multiple regression models, insecure attachment significantly predicted total and experiential negative symptoms but not expressive deficits. Total metacognition was also associated with adult attachment classification in all models for all categorisations of negative symptoms. These associations had best model fit statistics and lowest confidence intervals when associations were treated as correlated rather than a predictive relationship and when correlated between emotion regulation and metacognition was also modelled. Reappraisal and support seeking emotion regulation strategies also emerged as a significant predictor of experiential deficits which was not consistent with multiple regression models (ß= -0.270, 95% CI= -0.517 - -0.023, p=0.032). When both datasets were combined, associations generally replicated Dataset II but not Dataset I path models, this could be because the combination of participants across datasets added very few additional participants to these models. The best fitting models for Datasets I and II are described in figures 6.4-6.6.

Table 6.6: Fit indices for all path models estimated with MLR

Measure	Outcome	Model	Chi Square Statistic	DF	P-Value	CFI	AIC	RMSEA	CI Low	CI High	SRMR
Negative Symptoms Subscale – Positive and Negative Syndrome Scale (PANSS)	Total Negative Symptoms	1	5.663	3	0.129	0.382	364.190	0.223	>0.001	0.504	0.150
		2	5.766	3	0.124	0.343	364.378	0.230	>0.001	0.513	0.176
		3	5.766	3	0.124	0.343	381.166	0.230	>0.001	0.513	0.176
	Expressive Deficits	1	5.663	3	0.129	0.610	338.188	0.223	>0.001	0.504	0.144
		2	5.766	3	0.124	0.586	338.376	0.230	>0.001	0.513	0.171
		3	5.766	3	0.124	0.586	355.164	0.230	>0.001	0.513	0.171
	Experiential Deficits	1	5.663	3	0.129	0.635	341.808	0.223	>0.001	0.504	0.177
		2	5.766	3	0.124	0.611	341.996	0.230	>0.001	0.513	0.203
		3	5.766	3	0.124	0.611	358.784	0.230	>0.001	0.513	0.203
Clinical Assessment Interview for Negative Symptoms (CAINS)	Total Negative Symptoms	1	6.491	3	0.090	0.719	707.587	0.220	>0.001	0.455	0.127
		2	4.627	3	0.201	0.869	705.357	0.150	>0.001	0.403	0.129
		3	4.627	3	0.201	0.869	747.712	0.150	>0.001	0.403	0.129
	Expressive Deficits	1	3.897	3	0.273	0.880	706.499	0.104	>0.001	0.354	0.092
		2	2.432	3	0.488	1	704.783	>0.001	>0.001	0.294	0.086
		3	2.432	3	0.488	1	750.160	>0.001	>0.001	0.294	0.086
	Experiential Deficits	1	6.491	3	0.090	0.733	686.944	0.220	>0.001	0.455	0.129
		2	4.627	3	0.201	0.875	684.713	0.150	>0.001	0.403	0.131
		3	4.6327	3	0.201	0.875	727.068	0.150	>0.01	0.403	0.131

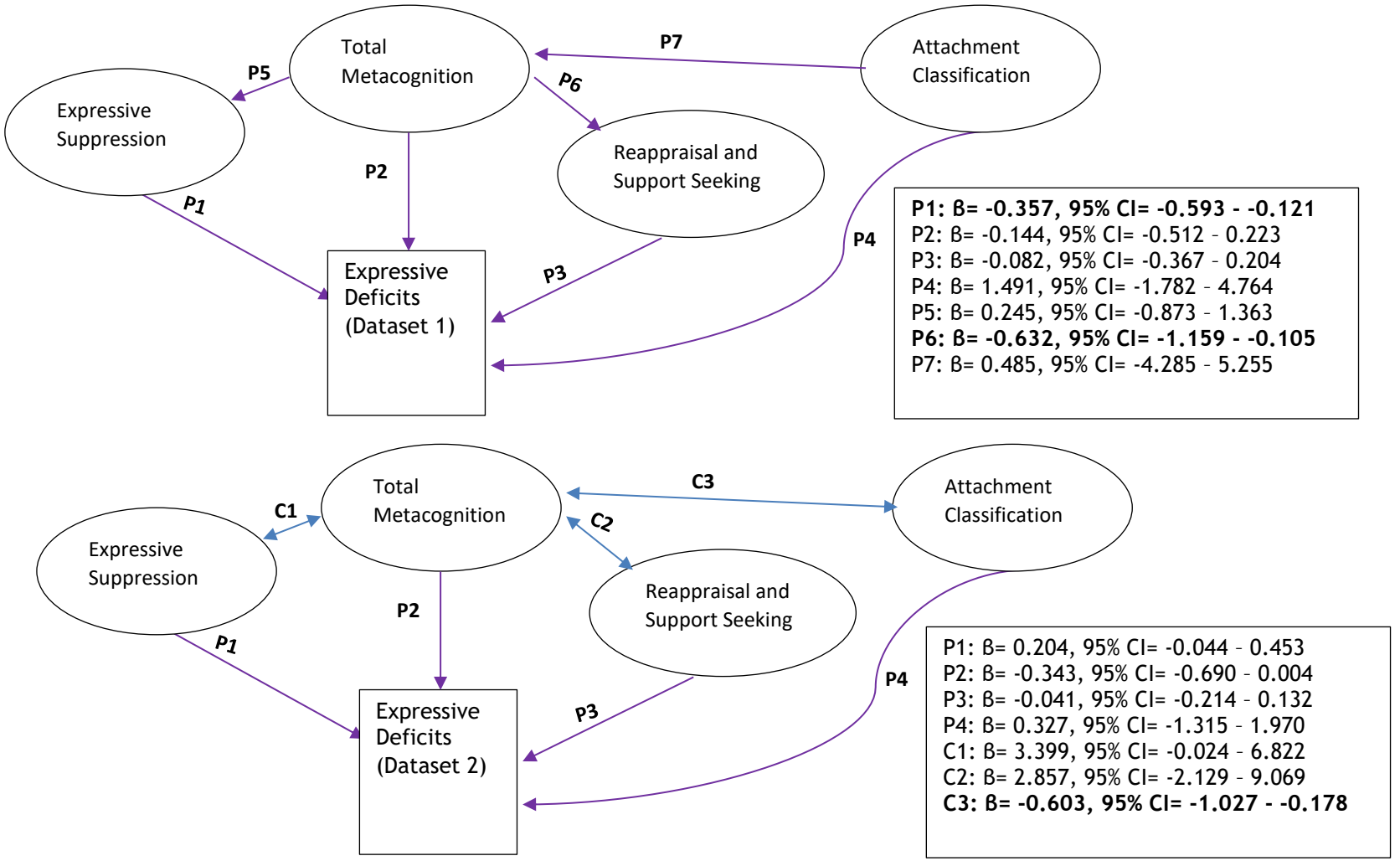
CFI: Comparative Fit Index; **AIC:** Akaike Information Criterion; **RMSEA:** Root mean square error of approximation; **CI Low:** lower bound confidence interval; **CI High:** Upper bound confidence interval; **SRMR:** Standardised Root Mean Square Residual

Figure 6.4: Best fit path models exploring attachment classification, metacognition and emotion regulation as related predictors of total negative symptoms:



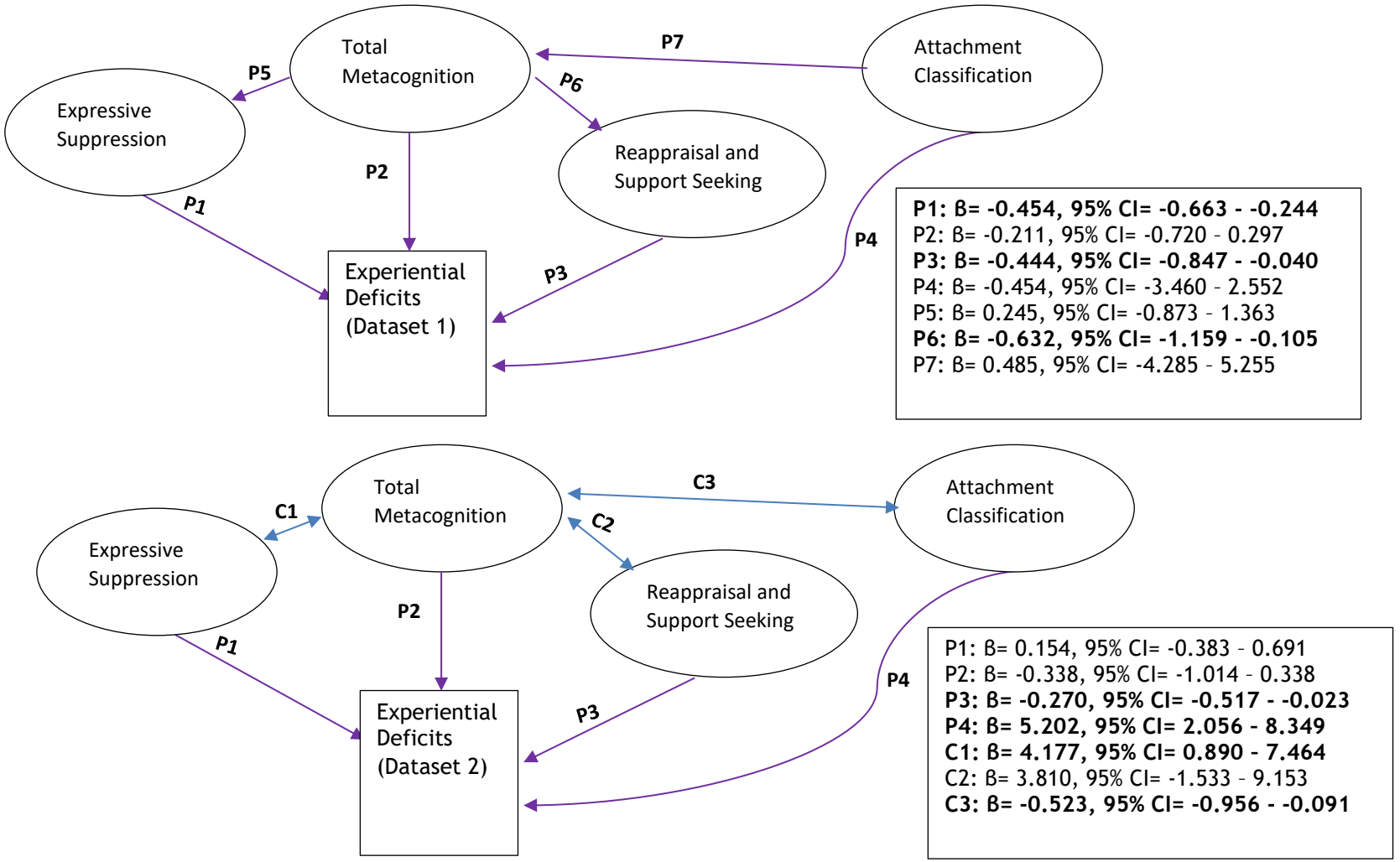
P: Path; **C:** Covariance, **bold values indicate statistical significance**

Figure 6.5: Best fit path models exploring attachment classification, metacognition and emotion regulation as related predictors of expressive deficits:



P: Path; **C:** Covariance, **bold values indicate statistical significance**

Figure 6.6: Best fit path models exploring attachment classification, metacognition and emotion regulation as related predictors of experiential deficits:



P: Path; **C:** Covariance, **bold values indicate statistical significance**

6.5 Discussion

This study analysed two archival samples exploring novel relationships which have not previously been examined with these data. Analyses aimed to investigate the relationship between attachment classification, metacognition and emotion regulation and levels of negative symptoms. Specifically, hypothesis one predicted that higher levels of negative symptoms would be associated with insecure attachment, lower levels of metacognition and lower levels of reappraisal and support seeking strategies. Higher levels of expressive suppression were also predicted to be associated with higher levels of negative symptoms. It was also anticipated that these finding would be replicated in a combined sample using standardised scores, allowing both datasets to be combined.

Hypotheses regarding attachment classification were not supported in Dataset I, but were supported in regression and path model analyses of total negative symptoms and experiential deficits in Dataset II and in the combined dataset. However, given that only 14 novel participants from Dataset I contributed to the combined dataset models, representing 32.6% of the overall sample, this likely explain why findings in the combined model were more consistent with Dataset II than I. The significant role of attachment is also inconsistent in these data, however across initial correlations, regression models and path analyses, significant associations were shown most consistently for total negative symptoms in Dataset II. It is however potentially important to note that attachment groups were much more unbalanced in Dataset I which might have impacted on the analyses. It is also unlikely that emotion regulation data obscured results as attachment did not emerge as a significant predictor when these variables were removed. A larger sample might detect more reliable associations between attachment classifications and negative symptoms as there would be a lower likelihood of a type II error (i.e. falsely supporting the null hypothesis).

There was some support for the proposition that metacognition predicts levels of negative symptoms. Both when analysed separately and as a combined data set there were significant associations between at least one subdomain of metacognition and negative symptoms in the regression models, and

decentration was the most consistent predictor across analyses. Total metacognition was not a significant predictor in any regression or path models, although total metacognition was correlated with expressive deficits in the combined dataset and an interaction effect between total metacognition and reappraisal and support seeking emotion regulation strategies was also observed. It is possible that the lack of association with total metacognition and negative symptoms is a small sample effect, or potentially driven by skew in the sample towards lower levels of metacognition. Alternatively, metacognition may influence negative symptoms indirectly, through impact on emotion regulation.

Directions of correlations between emotion regulation strategies and negative symptoms were in the expected direction; nonsignificant associations were seen between higher levels of negative symptoms were associated with less use of reappraisal and support seeking strategies and more use of expressive suppression. The latter result is perhaps unsurprising given expressive suppression is a fundamental component of negative symptoms. Yet, in Dataset I, associations with expressive suppression were significant in regression and path analyses models, however these associations less use of expressive suppression was associated with higher levels of negative symptoms. It is not clear why individuals with increased levels of negative symptoms would engage in less expressive suppression. One explanation could be that as sense of self is disrupted in the development and maintenance of negative symptoms, these individuals engage in less emotion regulation strategies overall (Favrod et al., 2019b). Alternatively, individuals with higher levels of negative symptoms may have difficulty accurately reporting use of expressive suppression due to low metacognition.

In contrast, significant associations were repeatedly present between reappraisal and support seeking emotion regulation strategies with experiential deficits and total negative symptoms, whereby decreased use of these strategies were associated with higher levels of negative symptoms particularly in Dataset I. In the combined dataset, these confidence intervals were much larger and it is possible that the sample in Dataset I is skewed to lower levels of use of emotion regulation strategies more generally based on descriptive statistics. Nonetheless, the repeated significance of reappraisal and support seeking emotion regulation

strategies might suggest that these are important targets for negative symptom treatment.

Finally, these analyses sought to assess the impact of interaction effects on levels of negative symptoms. Only in the combined sample were any interaction effects present on levels of expressive deficits only, and only the interaction between total metacognition and combined emotion regulation strategies which utilise reappraisal and support seeking were significant. It is possible that this is a spurious result as it contradicts analyses of each dataset separately and was underpowered. Although theoretically, an interaction between metacognition and emotion regulation could impact on negative symptoms as disrupted higher level metacognition (i.e. the MAS-A) could influence emotion regulation capacities over and above their existing impact on negative symptoms. For example, if the capacity to make integrated self-referential choices is impaired this might impact the successful use of reappraisal and support seeking emotion regulation strategies. Indeed, previous studies have found that metacognition has moderated relationships between emotion regulation and other outcomes, as opposed to having a direct effect (Bonfils et al., 2018).

Furthermore, path models suggested that the best fit models for the current data were those that constructed metacognition as predictive of emotion regulation in Dataset I. These models had slightly better fit than the models for Dataset II which constructed the relationship between these variables as simply correlated. Further research in larger samples is required to establish which of these findings are reliable.

6.5.1 Clinical implications

There are several theoretical and clinical implications that are suggested by these findings. Particularly, these data demonstrate repeatedly observed links between negative symptoms and several deactivating strategies. Insecure attachment can be conceptualised as a distress minimising response to interpersonal relationships (i.e. avoiding or minimising attachment responses as a strategy for coping with threatening life events; Gumley et al., 2014c), and negative symptoms have also been conceptualised as a deactivation response in the face of social stress (Berry et al., 2007). Furthermore, some researchers

identify negative symptoms as pathognomonic of emotion regulation difficulties, representing increased expressive suppression and increased reappraisal and support seeking, which involve active engagement with emotional experience (Kimhy et al., 2012). The current data demonstrated patterns of emotion regulation consistent with this in people with negative symptoms, and these mirror other datasets which show similar patterns in people with psychosis more generally (van der Meer et al., 2009).

The current data support these theoretical assumptions that negative symptoms are strongly related to broad deactivation strategies. However, due to the inconsistencies in these findings and cross-sectional nature of the analyses, longitudinal research is required to determine whether these findings show longitudinal causal pathways. Additionally, the data showed some support for the role of metacognition in predicting levels of negative symptoms, and associations between metacognition and both attachment and emotion regulation. Given that attachment classification is relatively stable (Bakermans-Kranenburg & van IJzendoorn, 2009) it may be a less amenable treatment target than metacognition. Further research could explore manipulation of metacognition in the treatment of negative symptoms, given that interaction effects in path models suggest the possibility that this could weaken use of deactivation strategies also. Furthermore, research suggests some effectiveness for treatments targeting emotion regulation (Favrod et al., 2019b) and for the use of mindfulness in improving emotion regulation in people with psychosis, but no specific effects on negative symptoms (Tabak et al., 2015). However, the current findings may offer add theoretical justification for inclusion of broader metacognitive strategies in approaching emotion regulation to ensure it can be applied effectively for people experiencing negative symptoms.

6.5.2 Strengths and limitations

These analyses help to identify the reliability of the relationships between negative symptoms, attachment classification and metacognition by replicating them in a novel sample. Additionally, the use of two datasets with different measures allowed exploration of whether these findings generalise when constructs are measured in a different way. The open science perspective adopted ensures that greater understanding of the factors which may contribute

to differences across the replication and original analyses can also be adequately explored.

However, overall ability to express certainty about the relationships between attachment classification, metacognition, emotion regulation and negative symptoms is limited. First, there was a high proportion of missing data and a very low number of participants contributed to overall analyses. Not all demographics were requested for comparison, particularly data on ethnicity. Furthermore, while specific predictors were identified very few overall models were statistically significant, and those that were might have been subject to overfitting. Some of these issues are likely to be affected by low sample power, as only the primary analyses models in the combined dataset were sufficiently powered, and only to detect large effects. Previous studies also do not indicate large effects between these constructs but rather small to moderate associations (see Chapters 3 and 4). Additionally, these data have been analysed and reported on elsewhere, meaning the risk of type I error is increased and data were non-normally distributed, potentially due to such a high proportion of missing data. There are additional sample parameters that influence the likelihood that these findings will generalise to other samples with negative symptoms.

Attachment groups were unbalanced and the association of avoidant versus preoccupied attachment with negative symptoms could not be explored post-hoc as insufficient participants would contribute to analysis. The levels of negative symptoms were also relatively low: PANSS negative symptom scores averaged 16.84 of a possible 62 in Dataset I and the CAINS averaged 12.71 out of 52 in Dataset II. Although an inverse relationship was still demonstrated, a full understanding of these associations might have been obscured by limited inclusion of individuals with severe negative symptoms. In comparison to Study 3 however, metacognition was also relatively low for these samples (between 11.17-12.70 out of a possible 28). Although an inverse relationship was demonstrated, generally low metacognition is anticipated to be associated with higher levels of negative symptoms. This raises additional questions around whether the use of an adolescent sample impacted results, and indeed some researchers question whether metacognitive processes may operate differently at different stages of illness, although there is limited evidence for this (Massé &

Lecomte, 2015; Vohs et al., 2014). Furthermore, this data was not from a psychosis specific sample which might have impacted findings.

Finally, although acceptable inter-rater reliability was demonstrated by Cohen's Kappa, the calibration and gold-standard rating criteria for the MAS-A were not achieved across the random sample which were independently rated by two researchers. While the largest discrepancy was 2.5 points this indicates that across the whole sample there is likely to be some deviation from gold standard rating of the MAS-A, impacting the accuracy of results. The MAS-A has demonstrated acceptable reliability in many studies, but the inter-rater reliability for many data is not reported (as demonstrated in the Risk of Bias assessment for the systematic review in Chapter 2). That this study demonstrated acceptable inter-rater reliability but did not meet gold standard calls into question how often gold standard for MAS-A is achievable across studies.

6.6 Conclusions

These findings demonstrate weak support for the role of metacognition, attachment classification and emotion regulation in predicting levels of negative symptoms in a FEP sample. Given that the sample has unbalanced attachment groups, and skewed towards lower levels of negative symptoms, further research is required to identify if these findings are replicable in a sample with more diverse negative symptoms. In context however, these findings are consistent with theoretical perspectives that negative symptoms are associated with deactivation strategies in relation to attachment relationships and response to emotion. Metacognition may theoretically explain processes through which complex interpersonal relationship responses and responses to emotion become fragmented and lead to the development and maintenance of negative symptoms. Further studies testing these models in samples with higher levels of negative symptoms is warranted.

Chapter 7: General discussion

Negative symptoms significantly impact on the social life and experience of pleasure for people with psychosis. However, negative symptoms in existing research are often treated as a homogenous construct and as a result knowledge about the mechanisms involved in the development and maintenance of negative symptoms is limited. Of potential mechanisms, metacognition appears to influence levels of negative symptoms over time (Hamm et al., 2012; McLeod et al., 2014) and may even be a pre-requisite of capacities disrupted by negative symptoms such as motivation (Luther et al., 2017). However, while metacognition and negative symptoms are clearly associated with one another, failures to account for the multidimensional nature of these constructs limits ability to examine whether components of metacognition might serve as suitable treatment targets for specific negative symptoms. This thesis therefore aimed to explore the relationship between these two constructs in persons with psychosis in more detail, to determine the role of metacognition in improving psychosocial recovery from negative symptoms.

7.1 Summary of findings

7.1.1 Study 1; chapter 3

Study one was a systematic review of previous research which had investigated the relationship between negative symptoms and metacognition. From narrative synthesis of the existing literature and collaboration with original authors to identify overlapping datasets, it was apparent that the relationship between negative symptoms and metacognition was seldom the focus of research. Despite this negative symptom data was often reported as a subtype of the Positive and Negative Syndrome Scale, a gold standard measure of psychosis symptoms. As a result, however, this meant that several studies had explored the statistical relationship between negative symptoms and metacognition and overall lower metacognitive ability predicted higher levels of negative symptoms. As a caveat to this, the utilisation of the same participants across multiple studies was not transparently reported, increasing risk of bias in the overall evidence base and signalling the need for an Individual Participant Data Meta-Analysis (IPDMA) to

explore the quantitative relationship between these constructs controlling for unique participants appropriately.

7.1.2 Study 2; chapter 4

Following guidelines to ensure sufficient similarity (Tierney et al., 2015), the data from 21 unique datasets equating to 1271 unique participants were collated in an IPDMA. The findings were consistent with the hypothesis that negative symptoms and metacognition are inversely related, although in contrast to expectations, metacognition and negative symptoms were more strongly related with each other when treated as summed, rather than subscale scores. Of the measured subscales, the capacity to develop a reflective understanding of increasingly complex aspects of the self and others (i.e. self-reflectivity, and understanding others' minds) were more important determinants of negative symptoms than other subscales. Some of the effects appeared stronger for expressive rather than experiential deficits of negative symptoms, but these findings were often not retained after controlling for covariates and were not as strong as associations between summed scores of the same constructs. Overall, the findings provided more nuanced information than the preceding systematic review, validating the rationale for this study. This approach also helped identify how sample representativeness and measurement variability might have obscured relationships between these constructs, validating the need for further research.

7.1.3 Study 3; chapter 5

In an attempt to investigate some of the measurement issues and statistical uncertainty noted, secondary data analysis was used in this chapter to explore the importance of the way in which metacognition is conceptualised. In particular, metacognition was compared with more developmental constructs of reflectivity capacity, such as attachment classifications and mentalisation, which are determined by the ability to form an understanding of one's own and others' mental states. The impact of these constructs on service engagement was also explored. Therefore Chapter 5 systematically investigated the associations between metacognition, mentalisation and attachment classifications and negative symptoms and service engagement.

Results were mixed, but the overall models including metacognition, mentalisation and attachment classification significantly predicted negative symptoms when classified as total negative symptoms and experiential and expressive negative symptoms. Of the independent variables, avoidant attachment and metacognition appeared most influential in predicting negative symptoms in several analyses, where mentalisation did not show a clear association. When metacognition subscale scores were used, decentration emerged most often as a significant predictor of negative symptoms, followed by understanding others' minds and self-reflectivity. Path analyses suggested that total metacognition was a strong predictor of experiential deficits, and avoidant attachment predicted expressive deficits. However, these results were interpreted with caution due to analyses being underpowered and the measurement and recruitment issues resulting in uneven and non-normally distributed samples.

7.1.4 Study 4; chapter 6

This chapter built on the results of Chapter 5 by comparing data in two novel archival samples to explore the relationship between metacognition, attachment classification and negative symptoms. As emotion regulation is also potentially altered in persons with negative symptoms (Strauss et al., 2018), and theoretically related to attachment (Gumley et al., 2014b) and metacognitive processes (Harder & Folke, 2012), the role of reappraisal and support seeking (a flexible and active emotion regulation strategy) and expressive suppression (an emotion regulation strategy focused on deactivation of emotion) were also explored in analysis.

The regression models exploring these variables were not significant, but this may be due to the sample not being sufficiently powered to detect predicted effect sizes (i.e. small to moderate). Total metacognition and all metacognitive subdomains, attachment classification and emotion regulation strategies emerged as significant individual predictors in analyses, although not consistently across datasets or specific classifications of negative symptoms.

Most consistently, insecure attachment predicted total negative symptoms and experiential deficits but not expressive deficits (in contrast to the findings of

Study 3). It is unclear why different classifications were significant for this study; levels of negative symptoms across both studies were similar and data had similar sampling issues. Given Chapter 6 demonstrated associations between avoidant attachment and total negative symptoms, an association with expressive deficits might also be anticipated. Possibly, associations with expressive deficits were not detected in this sample due to low power, which would be consistent with findings in chapter 5 where these associations were relatively small. Decentration and understanding others' minds also emerged as consistent predictors across analyses similar to Study 3 indicating that these are important factors involved in the development and maintenance of negative symptoms. While overall support is tentative, these data are consistent with the possibility that metacognition impacts on ways in which attachment and emotion regulation strategies are enacted in persons with negative symptoms, as demonstrated by interaction effects and path models.

7.1.5 Interpretation of findings

Taken together it is clear that the ability to make sense of self-referential experience and the mental states of others as measured by the Metacognition Assessment Scale is inversely related to negative symptoms. Theoretically, it is sensible that the ability to interpret self-referential experiences and interactions with others would influence levels of motivation, joy and social engagement. The most reliable findings (i.e. those derived from systematic review and meta-analyses of several datasets in Chapters 3 and 4) are surprising in that these associations are stronger for metacognition and negative symptoms treated as summed scores rather than their subcomponents. This also contrasts with findings in Chapters 5 and 6 where total metacognition was not consistently observed as a significant predictor of negative symptoms. These issues are perhaps driven the sampling issues across studies.

Across all chapters, there is limited inclusion of individuals with high levels of negative symptoms and the measure of negative symptoms most commonly used (the PANSS) has limited items contributing to subscales, which do not entirely encapsulate experiential difficulties common to negative symptom presentations (Marder & Galderisi, 2017). This means if the relationship between negative symptoms and metacognition is more pertinent for those with severe versus

lower levels of negative symptoms, these nuances would not be detected in the current analyses. Nonetheless, subdomains of negative symptoms and metacognition are related across all analyses, although less persistently meaning the reliability of these findings is low and larger samples which are more representative of the spectrum of negative symptom experience and levels of metacognition, especially including people with more severe deficits, are required to make further sense of these findings.

Chapters 5 and 6 also suggest that metacognitive capacity is likely to be somewhat associated with attachment classification, where avoidant or insecure attachment indicates poorer metacognitive abilities. However, these associations were not consistent across analyses, with some path models suggesting this association was better treated as correlated and some modelling metacognition as predicted by attachment classification. Furthermore, as the unit change in metacognition explained by attachment classification was between 0.523 and 5.122, these associations vary widely, and no models suggested that the variables included uniquely explain all variance in the relationship between negative symptoms and metacognition. Therefore, the mechanistic relationship between these constructs requires further exploration perhaps in a sample with a more balanced distribution of attachment classifications.

Other measures of reflective capacity, such as reflective functioning, do not demonstrate a consistent relationship with negative symptoms, despite also being associated with avoidant attachment and metacognition. This furthers the suggestion that the relationship between reflective capacity and negative symptoms is complex and likely dependent on the context and relationships being held in mind. Perhaps further research in more larger, adequately powered samples should explore the interaction between reflective function and attachment classifications as the impact of these factors on development and maintenance of negative symptoms may be more complex. At a more discrete level, emotion regulation could be considered reflective of individual metacognitive capacity to manage interpersonal affect. The relationship between metacognition, emotion regulation and negative symptoms makes theoretical sense, but requires further exploration in a larger sample to conclude any certainty in findings demonstrated in this thesis.

7.2 Theoretical Implications

7.2.1 Implications for theory involving variables tested in this thesis

The associations between metacognition and negative symptoms observed support the notion that metacognition is an important mechanism in negative symptom development and maintenance (Hamm et al., 2012; McLeod et al., 2014). While the results of the systematic review and IPDMA were largely cross-sectional, longitudinal associations also showed that metacognitive capacity predicted negative symptom levels over time. This indicates that improving metacognitive functioning may be important in improving psychosocial recovery from negative symptoms. The effect sizes shown were small to moderate (the largest effect size shown was the relationship between negative symptoms and metacognition in the IPDMA; ß= 0.688) which indicates a relatively consistent and robust association. In comparison, these associations are larger than some associations with lower-order cognitive and neurocognitive variables (Charernboon, 2020; Yolland et al., 2020) indicating that metacognitive ability merits substantial attention in the literature.

While an overall association was consistently shown, several research strands from this thesis indicate the way metacognition and negative symptoms are related is multifactorial and possibly non-linear. It is possible that the inconsistencies across the studied reviewed and conducted in this thesis are based on a more severe impact of metacognitive deficits for people who have higher levels of negative symptoms only, that is, there may be threshold effect. One possibility is that there is a compounding cycle of problems – for instance, as difficulties interpreting self-referential experiences persist, individuals may not only find it harder to initiate motivated behaviour, but also have fewer resources which are protective in maintaining motivation (i.e. social cognitive abilities, connections with others). This is similar to models of continued social and economic deprivation relating to psychosis (Hastings et al., 2020; Lee et al., 2020; Vargas et al., 2020).

The possible threshold effect was examined in the IPDMA sensitivity analyses, which did show that those people with high negative symptoms also had

significantly lower levels of metacognition, similar to the findings demonstrated in regression analyses. However, across all studies in this thesis, few of the participants displayed severe levels of negative symptoms (e.g. above 29 out of 49 on the PANSS negative symptoms subscale), and therefore the extent of non-linearity or potential cut-point effects remain unclear.

Taking a single symptom approach to modelling factors involved in the development and maintenance of negative symptoms has been of questionable value. Across studies, when metacognition was separated into subdomains, each of these subcomponents was associated with negative symptoms in some analyses and not others. There are possible measurement variance issues which contribute to this (i.e. the scale by which subdomains of metacognition is measured are much smaller than the scale for measuring total metacognition), however even controlling for this, associations with subdomains of metacognition and negative symptoms appear not as strong. If these associations are truly as small as described, then larger samples are required to reliably detect these associations.

This might also suggest that while it is not yet known which capacities are most influential, all elements of metacognitive ability, might play some role in the development and maintenance of negative symptoms. This includes the abilities required to make sense of one's own and others' experiences, integrate multiple perspectives that do not centre on the self, and apply that knowledge to approach psychological problems. This is aligned with the maintenance model described in the introduction, where multiple factors are implicated in the development and maintenance of negative symptoms. Indeed, research shows that across elements of metacognition there are consistent associations with psychosis symptoms more generally (Arnon-Ribenfeld et al., 2017). Similarly, while there is still debate about their relative influence, negative symptoms are associated with more simple forms of metacognitive ability (Brüne, 2014; Lysaker et al., 2013a; Lysaker et al., 2014b).

The role of attachment in Chapters 5 and 6 suggests that while metacognition may not be an entirely developmental construct, it is influenced by the capacity for attunement with others and being invited to consider close relationships with caregivers can have an impact on metacognitive abilities. This mirrors findings

that metacognition and attachment are somewhat related, but attachment does not explain the full variance in levels of metacognition (Dimaggio & Lysaker, 2015; Aydin et al., 2016). Perhaps to fully understand the relationship between interpersonal developmental constructs such as attachment and metacognition, these must be assessed as more dynamic constructs which fluctuate in the moment. For example, Hasson-Ohayon et al. (2020) explores how intersubjectivity, the process of generating shared understanding with another through interaction, can influence levels of metacognition by dynamically impacting one's interpretation of their self-experience, and certainty of these interpretations. Similarly, the fundamental nature of metacognition involves development of mental models which will determine expectancies for social situations based on knowledge of one's own cognitive resources; and expectations of others based on previous experiences (Brinck & Liljenfors, 2013). As adult attachment is explored using early caregiver relationships which are relatively distal, it is possible that considering more proximal relationships might give a clearer indication of how metacognition operates in the moment.

As mentalisation capacity is associated with attachment experience, it is surprising that mentalisation was not strongly associated with negative symptoms in study three, despite metacognition and avoidant attachment being associated. Gumley and Liotti (2018) suggest that mentalisation may be inhibited by persons with avoidant attachment. It might be that as a construct more closely associated with attachment (the beta-coefficients in study three showed that attachment classification explained more variance in reflective functioning than it did metacognition), when the attachment system is activated, the effects on mentalisation are more profound. If then the activation of avoidant attachment specifically leads to shut down of mentalisation, this could explain the limited measurement variance in study three samples (where avoidant attachment was the most predominant classification) and therefore the lack of association with negative symptoms. It would have been advantageous to include reflective functioning in analyses four, however there was insufficient data to include reflective functioning in these models.

The role of emotion regulation was only explored in Chapter 6, however findings suggest similar relationships between negative symptoms and emotion regulation strategies as demonstrated in psychosis literature more generally (van der Meer

et al., 2009). The specific associations between negative symptoms and different emotion regulation strategies have been less readily explored, however, some researchers have conceptualised that negative symptoms is deactivation as a response to social stress (Berry et al., 2007), and insecure attachment has been associated with reduced use of reappraisal and support seeking emotion regulation strategies and increased use of expressive suppression (Owens et al., 2013). The findings in study four were largely consistent with these associations.

Interactions between emotion regulation and metacognition were not a significant predictor of negative symptoms in regression models, however the pathways between metacognition and emotion regulation in were significant in several path models of negative symptoms. Given that emotion regulation can be conceptualised as a discrete metacognitive capacity (i.e. a response based on reflection about the mental states of the self and others; Schwannauer, 2013) it is perhaps unsurprising that these might be associated with integrative metacognitive constructs (i.e. the capacity to make sense of one's and other's mental states in increasingly complex situations). Further research is required to investigate whether overall emotion regulation is mediated by metacognitive ability in people with negative symptoms. There is some evidence to support this as emotion regulation has been shown to mediate the relationship between personal distress and empathetic responses to others affective states (Bonfils et al., 2018).

As both are affect-laden constructs, it is perhaps more surprising that the link between attachment and negative symptoms is not moderated by emotion regulation, however this is a similar finding as for other outcomes in the datasets explored (Thomson, 2019). Further research is required to explore if this is a study specific effect or a replicable result. Some studies suggest that emotion regulation responses might be different for individuals with preoccupied versus avoidant insecure attachment styles (Owens et al., 2013), which could alternatively explain why there were discrepancies in associations between emotion regulation and negative symptoms across datasets in study 4.

7.2.2 Applications to broader negative symptoms theory

The role of metacognition, attachment classification and emotion regulation are also potentially important in further research that test existing theory of other mechanisms of negative symptoms. If people have limited ability to synthesise their experience to make sense of current interactions and experiences they might rely more on heuristics and generalised beliefs (Robinson & Clore, 2002; Strauss & Gold, 2012). Individuals who are predisposed to self-defeatist beliefs might be at risk of increased likelihood of withdrawal if metacognition is poor and they rely on their belief that they are likely to experience failure if they engage in motivated activity (Grant & Beck, 2009) or that individual (as opposed to social pursuits are preferable (Beck et al., 2013). Furthermore, disrupted metacognition may influence interactions which then reinforce these beliefs. Similarly, neurocognitive difficulties making sense of the world (i.e. those described by Kring & Barch, 2014) are likely to impact metacognition through influencing individuals' ability to make sense of experiences on a more discrete level, and equally metacognition may have a top-down influence on neurocognition. These deficits could increase the likelihood that beliefs about limited cognitive resources are maintained and continue to impact functioning (Grant & Beck, 2009). Further research is required to investigate how higher and lower order cognitive processes integrate in people who experience negative symptoms to identify which components are most influential in their development and maintenance.

Finally, we know that negative symptom experiences are likely to vary in the symptoms experienced over time (Liemburg et al., 2020; Stiekema et al., 2018a). We also know metacognition is a relatively stable capacity (Lysaker et al., 2011i; Hamm et al., 2012) and further research is required to investigate how these capacities fluctuate over time in different groups. The studies in this thesis included a wide range of samples but analyses comparing participants on chronicity of symptoms, or predominant experiential or expressive deficits were limited. Furthermore, although covariates were significant in several analyses it was outwith the scope of this thesis to assess all demographic variables which are likely to have an influence (e.g. race, Bonfils, 2017). Given that recent research (Grant et al., 2012; Lincoln et al., 2017; Sevy et al., 2020) and evidence in this thesis demonstrate that the differentiation between negative

symptoms is important. Further research may benefit from use of more diverse cohorts to explore how the relationship between metacognition and negative symptoms may vary based on these characteristics.

Similarly, the multiple adversities that are experienced by many people with negative symptoms (including childhood and adulthood social adversity, Jaya & Lincoln, 2016; Turner et al., 2020b; and unmet social needs, Lincoln et al., 2021) are likely to impact on the opportunities individuals have to engage with social relationships which might foster metacognition. Furthermore, attachment categorisations and affective regulation strategies can be conceptualised as adaptive ways of responding to challenging environments (Groh et al., 2014). It might therefore be beneficial to explore how metacognition fluctuates in relation to these adversities and the impacts this has on negative symptoms, as well as sensitive ways of responding to these difficulties in therapy. Of existing research, poor metacognition is linked to poor functional outcomes, limited social opportunities and relationship difficulties (Hasson-Ohayon et al., 2017b; Wright et al., 2019a; Wright et al., 2020b). Furthermore, social cognition and metacognition are closely related. Given that these also are linked with negative symptoms, it is likely that the links between social adversities, negative symptoms and metacognition are important.

7.3 Clinical implications

There are several clinical implications of these findings that can be applied in several ways. Therapies targeting metacognition should be explored, and similarly existing therapies and models of service delivery may need to consider how best to incorporate individuals' understandings of themselves and others as they apply other therapeutic techniques to derive maximum effectiveness. There are also broader social initiatives which could have clinical significance in improving metacognitive abilities and therefore negative symptoms. Each of these will be discussed in turn.

7.3.1 Metacognitive therapies

In the introduction to this thesis several metacognitive therapies were outlined including Metacognition-Oriented Social Skills training (MOSST, Inchausti et al.,

2018); Metacognitive Reflection and Insight Therapy (MERIT, Lysaker & Klion, 2017); Metacognitive Interpersonal Therapy for Psychosis (MIT-p, Salvatore et al., 2009); and Mentalisation Based Treatment for Psychosis (MBT-p, Brent et al., 2014). Each of these are consistent with the integrative model of metacognition and focus on increasingly complex ways of understanding self-experience and the mental states of others. That findings show that metacognitive difficulties are strongly associated with negative symptoms it appears appropriate that these therapies might be used to improve metacognition, leading to psychosocial recovery from negative symptoms.

Existing research can support hypotheses around the likely mechanisms through which improved metacognition can lead to improved negative symptoms. Metacognition is likely to support regulation of motivation, pleasure and neurocognitive resource allocation for goal directed activity based on an understanding of oneself and others in a range of situations (Tas, 2013; Luther et al., 2016b). Given the salient role of amotivation in negative symptom experiences (Strauss et al., 2021a), improvements in amotivation may lead to improvements in other negative symptoms also. However, given limited evidence exploring the impact of negative symptoms on these therapies specifically, which of these are most optimal is unclear.

Given that MERIT incorporates use of the MAS-A, this treatment is most comparable to the understanding of metacognition operationalised in this thesis, meaning these findings are directly applicable to theory of change for this therapy. However, MERIT is also a long-term, highly flexible psychotherapy (Lysaker & Klion, 2017) which may mean it is difficult to deliver in practise without a high degree of training and time-resource. However, this thesis also suggests that metacognitive difficulties are inherently complex and multifaceted, which may preclude that resource intensity is necessary for successful improvement of metacognitive ability. As an alternative, mentalisation based treatment is more strongly influenced by an understanding of attachment discourse and reflective functioning. This may provide explicit benefits for individuals who appear to have specific relational difficulties or distress associated with attachment in addition to metacognitive deficits (Hauber et al., 2020; Morken et al., 2014). However, the specific treatment effects of any metacognitive therapy and their impact on negative symptoms is

still uncertain with very limited existing evidence. Therefore, further exploration of the impact of any of these therapies is required before they might be recommended.

7.3.2 Incorporating metacognitive information in existing therapies and service delivery models

Findings in this thesis show an association between metacognition, negative symptoms and attachment (a developmental measure of the level of attunement between oneself and others). This makes sense as both attachment organisation and metacognitive abilities are salient factors in the process of forming relationships (Aydin et al., 2016). This implies that mental health services might benefit from incorporating this knowledge to better model and understand service engagement. Gumley et al. (2014c) argues that overall systems in which services are situated require understanding of the threats and difficulties perceived by persons with psychosis to be an effective, safe base to engage in and promote recovery. If service users interpret the actions of services to be threatening, or these actions activate the attachment system, individuals may disengage to avoid painful experiences.

Furthermore, researchers suggest that therapist attempts to match the level of metacognition displayed to that of the service user might aid shared understanding in therapy and prevent potentially harmful experiences of shame or isolation through feeling unfathomable or misunderstood (Fonagy et al., 2011; Hasson-Ohayon et al., 2017b). Specifically, the association between negative symptoms and avoidant attachment might represent an increased likelihood of individuals shutting down in response to interventions they find threatening to their sense of self, preventing negative symptom recovery (Harder & Daniel, 2014). Addressing levels of attunement or metacognition within session could help resolve these ruptures. Additionally, promoting self-understanding through orienting to metacognitive ability in therapy can lead to the improvement of other capacities (Cella et al., 2016). Similarly, given that associations between metacognition and emotion regulation, greater consideration should be given to the impact of more integrative metacognitive ability on more discrete metacognitive capacities. This would have implications for neurocognitive, emotion regulation, and mindfulness specific therapies for example.

Considering these issues together, it might therefore be of benefit to incorporate assessment of metacognitive ability and attachment classification in mental health services. Furthermore, knowledge about metacognition could inform both staff training relevant to service delivery and reflective practise for clinical practitioners. Stemming from this, assessment of the level of attunement between staff, teams and service users may allow space for understanding and improving intersubjective coherence in services. This approach, where reflective capacity is emphasised in both service user and staff relationships, has already shown some success in adolescent populations (Bevington et al., 2015). This model has largely been developed with reference to mentalisation rather than attachment which is perhaps appropriate as it is more developmentally situated as a construct. Despite improving service engagement, negative symptoms remain a barrier in this approach (Griffiths et al., 2017), perhaps indicating that both direct therapeutic work targeted at improving metacognition and metacognition-oriented models of service delivery are required.

7.3.3 Broader societal context

Research suggests that poor metacognition is related to reduced social contact and social functioning difficulties, and mastery is especially linked to seeking social support (Lysaker et al., 2010a; Lysaker et al., 2013c; Massé & Lecomte, 2015). Negative symptoms are likely to be exacerbated by these issues, and continued social adversity is a barrier to negative symptom recovery (Jaya & Lincoln, 2016). Furthermore insecure attachment, which was consistently related to negative symptoms in samples 3 and 4, is indicated to be a response to challenging interpersonal environments (Gumley et al., 2014b).

Given the interrelatedness of these constructs, it is possible that providing structures for social engagement for people with negative symptoms can lead to improved metacognition, by stimulating the capacity for positive affect, and motivation for subsequent interactions. Indeed some studies have found that group metacognitive therapy, where interaction with others is an active treatment component, is positive experience for people with psychosis leading to improvements in metacognition (Inchausti et al., 2018; Lana et al., 2015; Lana et al., 2020; Weijers et al., 2020). However in addition to this, it is

possible that providing individuals with supportive social opportunities to build self-experience that is non-dependent on illness identity may also be beneficial (Tew et al., 2012). Few researchers have conceptualised how environmental factors act as mechanisms in the development and maintenance of negative symptoms, however theoretical accounts suggest these factors can be modelled and assessed (Strauss, 2021). Future research should consider how these structures interact with other intra- and inter-personal mechanisms of negative symptoms.

7.4 Methodological implications

The strengths of this thesis include the broad coverage of existing literature exploring the relationship between negative symptoms and metacognition, which increases confidence in the sensitivity of the findings in the systematic review and IPDMA. The thesis also incorporates use of longitudinal datasets which increases confidence that there is a mechanistic relationship between these constructs which is independent of study-specific effects. The use of secondary data is also economical and has aided in mitigating the effects of the COVID-19 pandemic on ability to collect primary care data from similar settings and participant groups as those explored in this research. This also allowed exploration of the differences between different populations including adolescents and adults, and first and multiple episode psychosis groups. Finally, the principles of Open Science have been employed in this thesis increasing the transparency and reproducibility of the work (Ross & Krumholz, 2013).

While this thesis presents a relatively comprehensive exploration of the relationship between metacognition and negative symptoms, there are several limitations also which merit the need for further research. These limitations are discussed briefly before suggesting areas for further research.

7.4.1 Sample representativeness

As already mentioned in this discussion, there was a low frequency of participants with severe levels of negative symptoms included in any of the studies. This could obscure the true relationship between negative symptoms and metacognition as individuals with more severe negative symptoms may

experience a stronger impact of metacognitive difficulties (Agelink van Rentergem et al., 2021; Harald & Gordon, 2012). Descriptively, the sample in the systematic review and IPDMA appears relatively diverse across other characteristics, with individuals from difference countries, duration of untreated psychosis, and race being represented across samples. However, as this was not quantified in analyses it is unclear to what extent some subgroups are underrepresented and how this impacts the results. Chapters 5 and 6 also included a broad sample, and not all individuals included had received a psychosis-specific mental health diagnosis. Additionally, only one dataset (Thomson, 2019) employed incorporates gender assignment out with male and female categories. How inclusion of these variables would influence the computational complexity of any future models is a continued challenge, and specific research exploring diverse characteristics is required.

All sample data also showed non-normality and particularly study data in Chapters 5 and 6 were underpowered to detect small to moderate effects, which is important given this size of effect is most common in previous literature. This perhaps indicates that the relationship between negative symptoms and important predictor variables, such as metacognition, are non-linear. Further information to understand these issues could perhaps be derived by recruiting samples with more severe negative symptoms or alternatively, replicating these findings in novel samples. One continued challenge to research in this area is that engagement in research by individuals with negative symptoms is historically limited due to presenting difficulties with motivation impacting recruitment and attrition (for discussion of these issues see Granholm et al., 2021b; Mahmood et al., 2021)

7.4.2 Measurement issues

Metacognition and negative symptoms are both multifaceted constructs that have been described in a multitude of ways in the introduction to this thesis (Chapter One). However, utilisation of these constructs is somewhat restricted to the measures available in the existing data analysed. In addition to this, the research conducted here inherits the psychometric issues noted in the original research. This includes poor interrater reliability for any measures, measurement variance issues or indeed unknown psychometric properties where

these have not been reported. The true extent of these issues across studies is unknown and could have a noticeable impact on the findings observed.

In analyses across this thesis (except Chapter 6), negative symptom conceptualisation is defined by the PANSS items used, on which there is limited consensus as to how negative symptoms can be best represented. Although individual items were discussed in the systematic review and analysed in the IPDMA, it might be difficult due to nature of the scores attributed to these items (1-7 on a Likert scale) to obtain sufficient measurement variance to detect statistically significant differences at this granular level (Flake & Fried, 2020). Additionally, items which best represent experiential and expressive deficit symptoms are debated and moreover this scoring does not distinguish individual expressive or experiential deficits which are arguably covered by several PANSS items (i.e. both “poor rapport” and “passive/apathetic social withdrawal” items in the PANSS could conceivably indicate levels of social amotivation). Finally, the PANSS doesn’t distinguish whether negative symptoms are primary or secondary (although approximations can be made; Galderisi et al., 2021b). Given that study 4 Dataset II shows similar significant associations between negative symptoms and metacognition as shown in preceding studies, this perhaps indicates the newer measures of negative symptoms which have better incorporated subjective experience associated with negative symptoms (Marder & Galderisi, 2017) are also suitable for use in this research area.

Similarly, metacognition can also be operationalised by a range of measures, each of which have found different levels of granularity when identifying subscales of metacognition through factor analyses (for example the Metacognition Assessment Interview has two subscales; MAI, Semerari et al., 2012; and the Metacognition Assessment Scale - Revised (MAS-R) has three; Carcione et al., 2010c). The MAS-R can also be explored at the individual item level also (i.e. the ability to identify emotions; MacBeth et al., 2014). More broadly, there are also several schools of thought which define metacognition slightly differently (i.e. the models described by Wells, 2011; Moritz et al., 2014 and others described in Chapter 2). Therefore inclusion of any of these models might have influenced results, as did inclusion of mentalisation which was not significantly associated with negative symptoms in study 3, despite being a similar theoretical construct.

Similarly, self-report measures of metacognition exist, including the Metacognition Self-Assessment Scale (MSAS; Pedone et al., 2017). Measures such as these might give additional insight into metacognitive processes and subjective understanding of these experiences. However, these ratings often do not significantly correlate with objective reports of metacognitive behaviour (Craig et al., 2020), perhaps indicating that participants could be limited by their ability to reflect on their own self-experience. Alternatively, other variables which are not accounted for might influence individuals' ability to report metacognitive experiences which correlate with their behaviour, such as attachment preoccupation.

There are additional variables which have been indicated elsewhere (i.e. self-defeatist beliefs; Rector et al., 2005; and reward-learning difficulties, Kring & Barch, 2014) which appear to be influential in the development and maintenance of negative symptoms. Incorporating these may have also impacted the results of this thesis particularly as researchers posit a hierarchical relationship between these constructs and metacognition, with synthesis of self-experience being a top-down influence on many of these processes, but bottom-up influences also being possible.

There is also significant conceptual overlap between negative symptoms, metacognition, and functioning items. Wright et al. (2019a); and Wright et al. (2020a) find the impact of controlling for negative symptoms when examining the relationship between metacognition and functioning is inconsistent, with one study showing that the association between metacognition remained significant, while the other did not. However, these analyses were conducted using the MAI, which has different subcomponents to the MAS-A. However, one of the possibilities which could explain these results is that metacognition, negative symptoms and functioning outcomes share considerable overlap which might mean they are better explained by some other latent construct.

7.4.3. Impact of COVID-19

COVID-19 is an infectious disease which has rapidly increased in prevalence since March 2020 resulting in a global pandemic. The resulting healthcare impact and infection control legislation and local healthcare procedures are likely to have

impacted on service provision, utilisation, and quality (Fusar-Poli et al., 2020; Moynihan et al., 2021). Preliminary studies suggest that the public health strategies aimed to mitigate the impact of COVID-19 including restricted social and physical contact with others, restrictions on leaving the house based on infection rates and one's own health, are likely to induce further deficits in people with negative symptoms such as social engagement, motivation and anhedonia (Strauss et al., 2021b). The impact of COVID-19 on the social and healthcare opportunities for people with negative symptoms should be monitored and considered in interpretation of future results. Additionally, the impact of COVID-19 might influence further research endeavours which must also be noted. A statement regarding the impact of COVID-19 on the development of this thesis can be found in Appendix 26.

7.5 Directions for future research

Given these issues several areas for further research are proposed.

- Research should seek to use methods which increase confidence in the reliability of the relationship observed between metacognition and negative symptoms. This could include analyses of the relationship between metacognition and negative symptoms in a larger, novel sample to explore some of the associations between subdomains of metacognition and specific negative symptoms that were underpowered to explore in this thesis. Additionally, with more targeted recruitment to include more individuals who experience severe negative symptoms, potential non-linear effects or cut-point analyses can be explored. Using new and alternative measures of metacognition and negative symptoms would also allow further examination of whether findings triangulate across measures. Specifically, using the CAINS (Kring et al., 2013) or BNS (Kirkpatrick et al., 2011) might allow more encompassing assessment of the relationship between subdomains of metacognition and the different types of negative symptoms since they incorporate subjective experience more explicitly.

- It also appears important to employ more dynamic methods in exploring the relationship between the variables outlined in this thesis. For

example, experience sampling methodology would allow individual responses to fluctuations in negative symptoms, metacognition, attachment system activation or emotional experience to be recorded in real time. This would allow a more mechanistic understanding of the way negative symptoms are maintained in the moment, and in what contexts, to be further developed (see Edwards et al., 2018; Kasanova et al., 2018). This could therefore inform more precise interventions and specifically, assessing higher- and lower- order cognitive variables alongside could allow development of more comprehensive theoretical models which could inform understanding of negative symptom experience. Furthermore, this could give better indications as to why some individuals with negative symptoms appear to recover over time while some do not (Gee et al., 2016; Lyne et al., 2018; Stiekema et al., 2018a).

- Further work in a larger sample would help establish whether the relationship between types of insecure attachment and emotion regulation strategies are reliably associated with negative symptoms. A larger sample would allow sufficient power to explore whether the either of these variables demonstrate interaction effects, between attachment and emotion regulation strategies and between metacognition and emotion regulation strategies. Longitudinal data would also support more mechanistic interpretations of these data by developing an understanding of any time dependency between negative symptoms and these variables. Additionally, instability in these associations would give a better understanding of how these mechanisms operate in relation to different courses of negative symptom experience.

- Preliminary research should be undertaken to explore whether metacognitive therapy is effective in treatment of negative symptoms and under what circumstances. This would allow researchers and clinicians to make a more informed decision around whether metacognitive therapy might be a more influential treatment approach as opposed to metacognitive adaptations to existing therapies. Additionally, if the mechanisms through which metacognitive therapy impact on negative symptoms are explored, a more mechanistic understanding of the two

constructs can be identified and assessed in application to a larger group of participants to examine whether these treatments have scalability.

- Importantly, given the risks of bias and limitations identified in the datasets used in this theses, it is imperative that future research seeks to implement rigorous methods, particularly around estimation of psychometric properties and transparently reporting the origin of data used.

7.5 Conclusions

In conclusion, this thesis contributes towards improving understanding of the relationship between metacognition and negative symptoms, conceptualised in several ways and examined in several different populations. Overall, findings comprehensively establish a small to moderate, inverse relationship between metacognitive ability and levels of negative symptoms. This suggests that metacognition may be an important treatment target in improving psychosocial recovery from negative symptoms. Further research is required to establish more precisely whether any subdomains of metacognition and negative symptoms are comparatively more strongly associated with one another. Additionally, more dynamic approaches to assessment of these constructs will help identify whether other variables, including emotion regulation, mentalisation and attachment classification influence these relationships. Ultimately, this will inform use of metacognitive processes in therapy to treat negative symptoms in a more individualised, mechanistic way.

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Appendices

Appendix 1: Search strategy for PsycINFO

S1: DE "Metacognition" OR DE "Mentalization" OR DE "Reflectiveness" OR DE "Insight"

S2: DE "Anhedonia" OR DE "Positive and Negative Symptoms" OR DE "Psychosis" OR DE "Schizoaffective Disorder" OR DE "Schizoid Personality Disorder" OR DE "Schizophreniform Disorder" OR DE "Schizotypal Personality Disorder" OR DE "Schizotypy" OR DE "Schizophrenia"

S3: "schizophreni*" OR "negative sympto*" OR "psychos?s" OR "schizoaffective" OR "PANSS" OR "psychotic" OR "positive and negative syndrome scale"

S4: "metacognition" OR "metacognitive" OR "metacognition assessment scale" OR "meta?knowledge" OR "metacomprehension" OR "mentali?ation" OR "mentali?ing" OR "meta-representatio*" OR "meta representatio*" OR "metarepresentatio*"

S1 OR S4

S2 OR S3

S5 AND S6

Appendix 2: Summary tables for systematic review

Acronyms used in all tables in appendix 2 summarised at the end of table 2.6.

Table 1.1: Summary of records from the Australia sample dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Bargenquast and Schweitzer (2014), Australia (Journal article)	Examines effectiveness of Metacognitive Narrative Psychotherapy for metacognitive capacity, narrative coherence and narrative complexity for people with schizophrenia.	Pre- and post-therapy design	Metacognitive Narrative Psychotherapy over 11-26 months	Patients meeting Diagnostic and Statistical Manual (fourth edition; DSM-IV) criteria for schizophrenia or schizoaffective disorder who were able to provide informed consent - No medication changes (2 months) - No hospitalisations (2 months) - No intellectual disability	Brief Psychiatric Rating Scale (BPRS)-Extended	MAS-A – Self-Reflectivity (SR) subscale	- Recovery Assessment Scale (RAS) - Indiana Psychiatric Illness Interview (IPII) - Narrative Coherence Rating Scale - Scale to Assess Narrative Development	Some participants demonstrated changes in negative symptoms (BPRS Apathy subscale) concurrent to changes in metacognition. No directly relevant analyses undertaken.

				- No high risk of suicide or harming others				
Schweitzer et al. (2017), Australia (Journal article)	Investigated long-term outcomes of Metacognitive Narrative Psychotherapy for people with schizophrenia.	2-year longitudinal follow-up design	Metacognitive Narrative Psychotherapy	Individuals from recruited non-government organisations, local psychiatrists, general practitioners, and the Australian Schizophrenia Research Bank who had a diagnosis of schizophrenia consistent with DSM-IV criteria and were able to provide informed consent. - No medication changes (1 month) - No hospitalisations (1 month)	BPRS – Extended – analysed with subscales identified by Thomas et al. (2004) meta-analysis	MAS-A – subscale and total scores	- RAS - IPII	Some participants demonstrated changes in negative symptoms (BPRS Apathy subscale) concurrent to changes in metacognition. No directly relevant analyses undertaken.

Table 1.2: Summary of records from the Canada sample dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**

Massé and Lecomte (2015), Montreal, Canada (Journal article; see also original thesis, Massé, 2017)	Examines whether there are distinct metacognitive profiles across individuals with a first psychotic episode and whether these profiles influence social functioning and perceived social support.	Cross-sectional (assumed) – secondary data analysis	None as part of this research however participants were recruited as a part of a larger study investigating processes involved in group Cognitive Behavioural Therapy (CBT) for individuals with early psychosis	Adults with First Episode Psychosis (FEP) with a diagnosis of a psychotic disorder as identified by medical records.	BPRS-E	MAS-A – Decentration subscale not included in analyses.	- Psychosocial Rehabilitation toolkit - First Episode Social Functioning Scale - Multidimensional perceived social support scale - IPII	No significant difference across participants grouped by metacognitive profile on BRPS negative subscale scores.

Table 1.3: Summary of records from the Chile sample dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**

Lysaker et al. (2018b), Chile (Journal article)	Examines the relative magnitude of metacognitive difficulties in persons with schizophrenia compared to persons with bipolar disorder and community controls and their relationship with negative and cognitive symptoms of psychosis in a Chilean sample.	Cross-sectional	None	Outpatients meeting International Classification of Diseases (10th edition; ICD-10) criteria for a Schizophrenia Spectrum Disorder (SSD) who regularly attend treatment. - No cognitive impairment which would prevent capacity to provide informed consent - No neurological disorders - No drug abuse (3 months) - No hospitalisations (3 months) - No medication changes (3 months)	Positive and Negative Syndrome Scale (PANSS) – analysed with the Bell et al. (1994) factor structure	MAS-A – translated to Spanish	- IPII (translated to Spanish) - Interpersonal Reactivity Index (IRI)	Significant correlation between MAS-A Understanding Others' Minds (UOM) and Mastery (M) subscales, and Total score and PANSS-NS, no other significant relationships. IRI and metacognition scores significantly predicted negative symptoms in a stepwise multiple regression. Mastery also significantly predicted negative symptoms in a subscale analysis.

Table 1.4 Summary of records for the Denmark sample 1 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Abu-Akel and Bo (2013), Denmark (Journal article)	Examines the mentalising/ metacognitive abilities of male and female patients with schizophrenia.	Cross-sectional, secondary data analysis.	None	Patients from psychiatric facilities meeting ICD-10 criteria for schizophrenia. - No antipsychotic medication changes - No acute psychosis - No organic disorder diagnosis - No patients influenced by alcohol or drugs	PANSS – abbreviated version.	Scored MAS-A using The Hare Psychopathy Checklist – Revised (PCL-R). Manual for scoring developed with P.L. - structure same as MAS-A. – only interested in total score, SR and Understanding Others' Minds (UOM)for the	- Demographics - Wechsler Adult Intelligence Scale (3rd edition; WAIS-III) - Vocabulary subtest - Global Assessment of Functioning (GAF) - Mentalisation ratings (created by authors) – categorical ratings of affective and cognitive	No significant correlations between PANSS-NS abbreviated version and MAS-A. Females significantly higher scores on MAS-A total score MAS-A-S and MAS-A-O, even when controlling for intelligence and psychopathology.

						purposes of this study	mentalising as represented by MAS-A Scores.	
Abu-Akel et al. (2015), Denmark (Journal article)	Examines association between psychopathy and metacognitive abilities in forensic patients with schizophrenia.	Cross-sectional, doesn't specify this as secondary data analysis.	None	Forensic patients from psychiatric facilities meeting ICD-10 criteria for schizophrenia. - No antipsychotic medication changes - No acute psychosis - No organic disorder diagnosis - No patients influenced by alcohol or drugs	PANSS – abbreviated version.	Scored MAS-A using the PCL-R. Supplementary material for scoring same structure as MAS-A. Decentration subscale excluded.	- WAIS-III (Vocabulary subtest) - Global Assessment of Functioning scale (GAF) - PCL-R	No significant correlations between PANSS-NS abbreviated version and MAS-A. Significant correlation between MAS-A subscales and total scores.
Bo et al. (2013), Denmark (Journal article)	Examines the role of personality pathology severity, mentalising/ metacognition and attachment in the occurance of aggression in patients with schizophrenia.	Cross-sectional, doesn't specify this as secondary data analysis.	None	Forensic in- or out-patients and non-forensic patients from general psychiatric units meeting ICD-10 criteria for schizophrenia (excluding code F21). - No acute psychosis - No organic disorder diagnosis	PANSS – original factor structure	Scored MAS-A using The PCL-R, manual for scoring developed with P.L. -structure same as MAS-A.	- MINI - WAIS-III (Vocabulary subtest) - GAF - The Affect Grid - Impulsive/ Premeditated Aggression Scale	No directly relevant analyses undertaken.

				- No patients influenced by alcohol or drugs.			- Aggression Rating Form - Relationship Questionnaire	
Bo et al. (2014), Denmark (Journal article)	Examines association between type of aggression, psychopathy, and metacognition in patients with schizophrenia.	Cross-sectional, doesn't specify this as secondary data analysis.	None	Inpatients and outpatients from psychiatric facilities meeting ICD-10 criteria for schizophrenia. - No acute psychosis - No organic disorder diagnosis - No patients influenced by alcohol or drugs	PANSS-abbreviated version, measures 8 items in total 3 from both positive and negative symptom subscales and 2 from general psychopathology subscale (as per original factor structure)	Scored MAS-A using the PCL-R. Manual for scoring developed with P.L. - structure same as MAS-A. For the purposes of this study generated Total score, and categorical scores derived from SR and UOM.	- PCL-R - Impulsive/ Premeditated aggression scale - Aggression Rating form - Structured Clinical Interview for DSM (SCID) for Axis-II Personality Disorders - The Affect Grid - GAF - MINI - WAIS-III (Vocabulary subtest)	No directly relevant analyses undertaken.

Bo et al. (2015), Denmark (Journal article)	Examines the association between metacognition and global social functioning and symptom severity in primarily criminal and violent patients with schizophrenia. Particular interest in whether deficits in metacognition specifically related to negative symptom deficits; particularly blunted affect and emotional withdrawal.	Cross-sectional, secondary data analysis	None	Inpatients and outpatients from psychiatric facilities with a criminal background, aged 18 or above who meet ICD-10 criteria for schizophrenia. - No acute psychosis - No organic disorder diagnosis No patients influenced by alcohol or drugs	PANSS – specifically the following items: - Hallucinations - Delusions - Blunted Affect - Emotional Withdrawal	Scored MAS-A using the PCL-R. Scoring structure the same as the MAS-A	- PCL-R - The Affect Grid - GAF - MINI (number of major Axis-I disorders)	Significant correlation between Decentration and emotional withdrawal – no other significant correlations between PANSS blunted affect and emotional withdrawal items and MAS-A subscales or total score.

Table 1.5: Summary of records for the Denmark sample 2 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative**

					Measures and Adaptations			**Symptoms and MAS-A**
Austin et al. (2019), Region Zealand, Denmark (Journal article; see also conference abstract, Austin et al., 2018)	Examines whether metacognition is predictive of negative symptoms in participants with FEP after 3 years, at the level of total and individual negative symptoms.	Follow-up study	All participants were enrolled in the OPUS treatment for individuals ages 18-35 with first episode non-affective psychosis – a 2 year manualised treatment programme including assertive outreach, psychoeducation and family involvement.	Danish speaking FEP patients in the OPUS programme aged 18-35 meeting ICD-10 diagnostic criteria for codes F20-F29. - No individuals with diagnosis code F21	PANSS – analysed individual items, PANSS-NS (as per the van der Gaag et al., 2006 factor structure) and PANSS expression/ experiential deficits (defined by Harvey et al., 2017), whereby PANSS expression consists of blunted affect, poor rapport, lack of spontaneity and motor retardation; and PANSS experiential consists of emotional withdrawal,	MAS-A	- Premorbid adjustment scale (PAS) - Duration of Untreated Psychosis (DUP; time from emergence of first positive psychotic symptoms (measured with PANSS items) to first adequate treatment) - GAF - IPII	Expressive negative symptom domain significantly correlated with SR, no other significant correlations, and experiential domain was not significantly correlated with any MAS-A subscales. PANSS individual negative symptom items (excluding difficulty in abstract thinking), expressive and experiential components, and overall NS score, all significantly correlated with MAS-A Total score

					passive social withdrawal, and active social avoidance.			at baseline, individual experiential items, total score, and expressive component all significantly correlated at follow-up. Significant relationship retained for blunted affect and poor rapport when controlling for baseline negative symptoms.
Jansen et al. (2017), Denmark (Journal article)	Examines whether metacognitive mastery in patients with FEP and their caregivers is related to positive and negative	Cross-sectional, analysis of previously recruited sample	None delivered as part of this research, although data came from participants enrolled in a larger study	Persons aged 18-35 meeting ICD-10 criteria for a SSD enrolled in treatment within a region of Denmark for whom this was their first ever psychiatric treatment because of this disorder.	PANSS – used to identify DUP (psychotic symptom score $\geq$ 4 for a week or several times for several weeks)	MAS-A – interested in mastery only for the purposes of this study.	- IPII - Experience of Caregiving Inventory - Family Questionnaire	Patient and maternal mastery, patient mastery and negative caregiver experiences, and caregiver critical comments, and also all multiple

	caregiver experiences; caregiver critical comments and over-involvement and DUP.		examining caregiver distress and family interventions.	- None meeting criteria for ICD-10 SSD code F21 - Sufficient Danish skills to complete interview - Living with biological maternal caregiver	Negative and positive symptoms subscales analysed with Bell et al. (1994) factor structure			regression analysis including these variables and DUP, were not significantly influenced by negative symptoms.
Trauelsen et al. (2016), Region Zealand, Denmark (Journal article; see also thesis, Trauelsen, 2015)	Examines metacognitive difficulties in FEP comparted to non-clinical controls and relationship of metacognitive difficulties to positive and negative symptom profiles	Cross-sectional, secondary data analysis	Participants were taking part in an Early Intervention (EI) programme (called OPUS) for people with FEP	Participants of the EI programme for people with FEP; with an OPCRIT (Operational Criteria System) confirmed ICD-10 diagnosis (codes F20-F29) of a SSD, aged 18-35 years who had sufficient Danish skills to complete the interviews - No ICD-10 F21 diagnosis - No psychosis due to organic causes - No previous diagnosis of non-affective psychosis	PANSS – interview was extended to include lifelong symptoms and used the van der Gaag et al. (2006) factor structure in analysis	MAS-A	- IPII - Childhood Trauma Questionnaire (CTQ) – Danish Version - Childhood Experience of Care and Abuse Questionnaire (CECAQ) - DUP - Parental education	PANSS-NS significantly correlated with MAS-A total score and all subscales. MAS-A total score and all subscales significantly correlated with each other. Participants grouped on positive and negative symptom profiles significantly

								different on metacognition.
Trauelsen et al. (2019), Denmark (Journal article)	Examines the relationship between metacognition and childhood trauma in people with non-affective FEP, controlling for demographics, 1st degree psychiatric illness, and negative symptoms	Cross-sectional study, secondary data analysis	Participants took part in OPUS – an EI service for individuals with FEP in Denmark	Adults Aged 18-35 with an OPCRIT confirmed ICD-10 diagnosis of schizophrenia (diagnostic codes F20-29) - No-one meeting diagnostic code F21 - Sufficient Danish skills to carry out the interviews.	PANSS – used as part of determining whether individuals met diagnostic criteria – extended to include lifelong symptoms, categorised by van der Gaag et al. (2006) factor analysis.	MAS-A	- IPII - CTQ - CECAQ - Brief Betrayal Trauma Survey	MAS-A Total and subscale scores all significantly correlated with PANSS-NS and with each other. Addition of negative symptoms to model predicting metacognitive levels (including other variables related to childhood trauma) significantly improved variance described by the model for all MAS-A subscales.

Table 1.6 Summary of records from the Denmark sample 3 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Vernal et al. (2018), Denmark (conference abstract)	Examines factors associated with symptoms in patients with first-episode schizophrenia aged 18-35 years, including psychopathology, cognitive and psychosocial functioning, suicidality, insight, metacognition, drug attitudes, side-effects, trauma history and autistic traits	Repeated measures design	Participants were recruited from OPUS – the EI service in Denmark for individuals with FEP	Patients with first-episode schizophrenia aged 18-35 years	PANSS	MAS-A	- GAF - Clinical Global Impression (CGI) - Yale-Brown Obsessive Compulsive Scale - Cognitive Distortions Scale - WAIS - Cambridge Neuropsychological Test Automated Battery - Personal and Social Performance Scale (PSP)	Insufficient details on relevant analyses reported

							- Columbia Suicide Severity Rating Scale - IPII - MAS-A - Beck Cognitive Insight Scale (BCIS) - Birchwood insight scale - Drug Attitude Inventory-10 - Brief Trauma Questionnaire - Autism spectrum Quotient	

Table 1.7: Summary of records for the England sample 1 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A

Davies et al. (2017), Sussex, England, UK (Journal article)	To explore the relationship between metacognition, neurocognition and functional capacity and social and occupational functioning in people with FEP	Cross-sectional	None	Outpatients from an early psychosis service with a current diagnosis of FEP over the age of 18. - No primary diagnosis of substance misuse - No primary diagnosis of organic neurological impairment. - No insufficient language skills to complete the assessments	PANSS – original factor structure used	Used the Metacognitive Assessment Interview (MAI)	- Wechsler Memory Scale (3rd Edition; WMS-III) subscales - verbal fluency - the TrailMaking Test (TMT) - Wechsler abbreviated scale of intelligence - demographic information - medication information (converted to olanzapine equivalent doses)	No directly relevant analyses undertaken which were feasible (relationships between metacognition, negative symptoms and functional capacity did not demonstrate adequate model fit statistics)
Wright et al. (2019b), Sussex, England (Journal article; see also	Examined whether self-defining memories were less specific, less	Cross-sectional study	None reported	Outpatients from EI in Psychosis services who had received a formal FEP diagnosis by a psychiatrist	PANSS – analysed using the original	MAI - interested in the total composite score (composed of	- SDM questionnaire - verbal fluency task	No directly relevant analyses undertaken

conference abstract, Wright et al., 2018a)	integrated and more negative in FEP groups compared to healthy controls and whether specificity and integration of Self Defining Memories (SDM) was associated with metacognition and functioning.			- No primary diagnosis of substance misuse disorder or organic neurological impairment. - matched on age, gender and education with control group sample	factor structure	averages of each subscale total score) for this study	- TMT - WMS-III subscales - vocabulary and matrix reasoning tasks - Time Use Survey (TUS) - UCSD Performance-based Skills Assessment (UPSA)	
Wright et al. (2019a), Sussex, England (Journal article; see also conference abstract, Wright et al., 2018b)	Examined whether neurocognition, functional capacity and metacognition predict future outcome in individuals with FEP, and whether metacognition was predictive of functional outcome independent of	Longitudinal follow-up study	None reported	English-speaking outpatients from a FEP service meeting ICD-10 criteria for FEP (diagnostic code F29) aged 18-40. - No primary diagnosis of substance misuse disorder or organic neurological impairment - Using EI services for at least 3 months before beginning of study	PANSS – used original factor structure in analyses	MAI - interested in the total composite score (composed of averages of each subscale total score) for this study	- TUS - UPSA - WMS-III subscales - Trail Making Task (TMT) and Verbal Fluency - Vocabulary and Matrix Reasoning Tasks	MAI baseline and follow-up total composite scores significantly correlated with PANSS-NS baseline and follow-up scores. Negative symptoms did not significantly alter statistical significance of

	neurocognition, negative symptoms and functional capacity							relationship between metacognitive ability and functional outcome.

Table 1.8: Summary of records for the Germany sample dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
Bröcker et al. (2017), Berlin, Germany (Journal article)	To validate a German translation of the MAS-A, and compare with converging and discriminant measures of metacognition for individuals with a SSD.	Cross-sectional	None	In- and out- patients meeting ICD-10 criteria for a SSD.	PANSS - analysed with van der Gaag et al. (2006) factor structure.	MAS-A translated to German and ratings generated from a modified semi-structured interview, observing the principles of Operationalised	- Psychological Mindedness Scale (German version) - Metacognitions Questionnaire (German version) - Mentalisation Questionnaire	No significant correlations between MAS-A subscales and total score and PANSS-NS. Significant correlations between MAS-A subscales, and MAS-A subscales and total scores. No

						Psychodynamic Diagnosis.	- BCIS (German version) - IRI - Attributional Complexity Scale (German translated short version) - Forms A and B of the Levels of Emotional Awareness Scale - The Movie for the Assessment of Social Cognition - German Vocabulary test - Auditory Verbal Learning Test - GAF	other directly relevant analyses undertaken.

Table 1.9: Summary of records from the Israel sample dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Rabin et al. (2014), Israel (Journal article)	Examines whether relationship between metacognition and social quality of life is mediated by positive and negative symptoms of schizophrenia in persons with schizophrenia and by schizotypy traits in persons without mental illness	Cross-sectional	None	Outpatients from the psychiatric unit of Soroka University Medical Centre or the Beer Yaakov Mental Health Centre - Schizophrenia diagnosis (1 year) - No other psychiatric diagnosis - No neurocognitive disorder	PANSS – original factor structure (only positive and negative symptom subscales analysed)	SR, MAS-A- UOM	- IPII - Oxford-Liverpool Inventory of Feelings and Experiences - Hebrew translation and adaptation of the social quality of life subscale of the Wisconsin Quality of Life Index for Mental Health	SR and UOM significantly correlated with PANSS-NS and with each other. Negative symptoms mediated the relationship between UOM and Social quality of life.

Table 1.10: Summary of records from the Italy sample dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Nicolò et al. (2012), Rome, Italy (Journal article)	Examines relationships between metacognitive capacity and select negative, positive and depressive symptoms, insight and neurocognitive deficits in Italian outpatients with schizophrenia.	Cross-sectional, not clear that using data reported previously	None	Outpatients meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No psychiatric admission (6 months) - Mo medication changes (1 month) - No housing changes (1 month) - No mental retardation - No active substance abuse	PANSS – analysed the same items which were measured in a previous USA study (Lysaker et al., 2005; hallucinations, delusions, suspiciousness, blunted affect, emotional withdrawal, disturbance of volition, and depression)	MAS-A SR, UOM & Mastery - based upon IPII interviews which were conducted in Italian	- Rey's 15-word list - Wisconsin Card Sorting Test (WCST) - WMS (Visual Reproduction subscale) - a visual memory test - WAIS-Revised (Digit Symbol and Vocab) - Scale to Assess Unawareness of Mental Illness (SUMD) – Italian Version	Controlling for age and education, blunted affect significantly correlated with SR and UOM, emotional withdrawal significantly correlated with SR and disturbance of volition significantly correlated with SR and total metacognition. No other significant correlations found. No other directly

							- IPII (Italian translation)	relevant analyses undertaken.
Popolo et al. (2017), Italy (Journal article)	Examine metacognitive capacity across patients with schizophrenia and bipolar disorder, and control groups and comparisons with symptoms.	Cross-sectional, not clear that using data reported previously	None	Outpatients meeting DSM-IV-Text Revised (DSM-IV-TR) criteria for a SSD - No disability or cognitive impairment - No neurological disorders - No drug addiction (1 month) - No hospitalisations (1 month) - No medication changes (1 month)	BPRS – developed 5 scales from the 18 item version (Anxiety/ Depression; Withdrawal/ Retardation; Thinking Disturbance; Activation; Hostility and Suspiciousness)	MAS-A	- IPII - Metacognition Questionnaire-30	BRPS Withdrawal/ retardation subscale score correlated significant with SR and UOM and total metacognition. No significant correlations with Decentration or Mastery. No other directly relevant analyses undertaken.

Table 1.11: Summary for the records from the Netherlands sample 1 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**

de Jong et al. (2016), Netherlands (Journal article)	To assess the feasibility of delivering a shortened version of Metacognitive Reflection and Insight (MERIT) for people with schizophrenia	Repeated measures design	MERIT – 12 sessions	Outpatients from mental healthcare institutes, aged 18 or over who met DSM-IV-TR criteria for schizophrenia, who were able to give informed consent and who presented with metacognitive difficulties. - No medication changes (30 days) - No acute psychosis (PANSS ≥4) - No comorbid neurological disorder (patient file) - No severe substance dependence (patient file) - Intelligence Quotient (IQ) > 70 (patient file)	PANSS – analysed using van der Gaag et al. (2006) factor structure (confirmed via personal communication)	MAS-A	- IPII - Faux-Pas Test - BCIS - IRI - Quick Inventory of Depressive Symptomatology - Internalised Stigma of Mental Illness Scale (ISMIS) - Manchester Short Assessment of Quality of Life (MANSA) - PSP - CGI	No directly relevant analyses undertaken.

Table 1.12: Summary of records for the Netherlands sample 2 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
de Jong et al. (2018c), Netherlands (Journal article; see also conference abstract, de Jong et al., 2018b)	Assessment of the effects of MERIT on metacognition for individuals with schizophrenia	Randomised Controlled Trial (RCT)	MERIT (40 sessions vs treatment as usual	Outpatients aged 18 years old or over meeting DSM-IV-TR criteria for schizophrenia or schizoaffective disorder, who were able to give informed consent. - No medication change (30 days) - No acute psychosis (assessment PANSS positive symptoms >4) - No neurological disorder in patient file - No diagnosis of severe substance dependence	PANSS – van der Gaag et al. (2006) factor structure used in analyses (confirmed via personal communication)	MAS-A	- IPII - BCIS - CGI - Empathic Accuracy Task - Faux-Pas Test - IRI - ISMIS - MINI - PSP - Questionnaire of Cognitive and Affective Empathy - Quick Inventory of Depressive Symptomatology - Self-Report	No directly relevant analyses undertaken.

				- No impaired intellectual functioning in patient file (IQ < 70)			- Self-Rated MANSA - Work Readiness Questionnaire - Dutch Adult Reading Test - TMT (A&B) - WAIS (Digit Symbol Test)	
van Kleef et al. (2015), Netherlands (Journal article)	Examines relationships between metacognition and cognitive and social functioning and whether metacognition plays a mediating role in these relationships, controlling for symptom severity, in people with schizophrenia.	Cross-sectional, secondary data analysis	Participants had taken part in a trial of MERIT	Adults meeting DSM-IV-TR criteria for schizophrenia or schizoaffective disorder - No medication changes (30 days) - Impaired metacognitive difficulties - No active substance dependence - No co-morbid neurological disorders - No IQ < 70) - No florid psychosis (a mean score of 7 or more on PANSS) and mean	PANSS – used to define symptom severity of patients	MAS-A – also used to identify whether participants had sufficient metacognitive deficits in each domain	- MINI - PSP - TMT - WAIS (Digit Symbol subtest) - IPII	UOM and total metacognition correlated significantly with PANSS-NS, no other subscales significantly correlated. SR correlated with all other subscales and total score, UOM correlated with SR only, Decentration and Mastery correlated with total MAS-A, and no

				PANSS score of < 4 on PANSS positive subscale				other significant relationships identified. No other directly relevant analyses undertaken.

Table 1.13: Summary of records for the Netherlands sample 3 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
de Jong et al. (2018a), Netherlands (Journal article)	Examines relationship between social cognition, metacognition and violent history in people with schizophrenia.	Cross-sectional	None delivered as part of this research, although data came from participants previously recruited to a RCT investigating metacognitive	Patients aged 18 or older from a forensic clinic with a history of violent crime, and individuals without a forensic history, who met DSM-IV-TR criteria for schizophrenia or schizoaffective disorder - No medication changes (30 days)	PANSS – van der Gaag et al. (2006) factor structure used in analyses (confirmed via personal communication)	MAS-A	- MINI - TMT (A&B) - WAIS (Digit Symbol Test) - IRI - Questionnaire of Cognitive and Affective Empathy - Faux-Pas Test	No directly relevant analyses undertaken.

			therapy where they were excluded for not meeting criteria	- No acute psychosis (PANSS >4) - No comorbid neurological disorder (assessment) - Ability to read/write (assessment) - No patients with an IQ lower than 70 (assessment)			- Empathic Accuracy Test - Dutch adult reading test - IPII	

Table 1.14: Summary of records from the Scotland sample 1 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Mitchell et al. (2012), Scotland (Journal article)	Examines metacognition patterns in schizophrenia patients with and without a history of	Cross-sectional (assumed)	None	Forensic patients from Forensic Mental Health Services and outpatients in Community Mental Health Teams with a diagnosis of schizophrenia (or similar)	PANSS – original factor structure	MAS-Revised (MAS-R) – decentration not a subscale in this model but categorised under the	- NICR	PANSS-NS was significantly correlated with the MAS-R-UOM and Mastery. No other directly relevant

	interpersonal violence.			- Aged 18-64 - Forensic patients with Historical, Clinical and Risk Management (HCR)-20 identified history of interpersonal violence - No community mental health team participants with known history of violence		"Understanding Others' Minds" category – obtained with narratives from the Narrative Interview for Compassion and Recovery (NICR)		analyses undertaken.
Reilly (2011), Scotland (Thesis)	Explores relationship between metacognition and attachment anxiety, attachment avoidance, symptom experience and interpersonal difficulties in people with a diagnosis of Borderline	Cross-sectional	None	Patients from secondary level specialist and generic services including psychotherapy, outpatients clinical psychology departments, inpatient psychiatric services and specialist trauma teams meeting DSM-IV criteria for affective and non-affective psychotic disorder with sufficient English language to undertake interview - Aged 18-64 years	PANSS – analysed using original factor structure (confirmed via personal communication)	MAS-R – decentration not a subscale in this model but categorised as an item under "Understanding Others' Minds"	- NICR - Brief Symptom Inventory-54 - Inventory of Interpersonal Problems-32 - Relationship Style Questionnaire	No significant kendall's tau correlations between MAS-R subscales and PANSS-NS

	Personality Disorder (BPD) or psychosis			- No comorbid BPD diagnosis - No learning disability - No primary diagnosis associated with psycho-active substance use - No organic disorder				

Table 1.15: Summary of records from the Scotland sample 2 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
MacBeth et al. (2014), Scotland (Journal article)	Explores correlations between metacognition, symptoms and premorbid functioning in an FEP sample. Specific interest in the relationship	Cross-sectional	None for this research	Individuals in their first 12 months of treatment for FEP meeting DSM criteria for an affective or non-affective psychotic disorder with capacity to consent - 1st presentation to clinical services with psychotic symptoms	PANSS – van der Gaag et al. (2006) factor structure used in analysis	MAS-R – decentration is not a subscale in this model but is captured under "Understanding Others' Minds". Derived from Adult Attachment	- DUP - PAS - Service Engagement Scale - AAI	Significant relationship between MAS-R-UOM and PANSS-NS. No other directly relevant analyses undertaken.

	between metacognition and negative symptoms.			- Positive symptoms of sufficient severity and/or distress to require antipsychotic medication - No substance misuse, head injury or organic disorder as primary cause of psychotic symptoms		Interview (AAI) narratives		

Table 1.16: Summary of records from the Scotland sample 3 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
McLeod et al. (2014), Scotland, (Journal article; see also conference abstract, McLeod et al., 2013)	Examines whether metacognitive capacity is associated with subtypes of psychotic symptoms, particularly negative symptoms,	Repeated measures design	None	Inpatients and outpatients with a first presentation to mental health services for psychosis who met DSM-IV-TR criteria for schizophrenia, schizophreniform disorder, schizoaffective	PANSS – used van der Gaag et al. (2006) factor structure for analysis	MAS-A – based on AAI transcripts	- PAS	MAS-A subscales significantly negatively correlated with negative symptoms at 6 months, no significant correlations at 12 months (1 trend,

	over time in people with early psychosis, controlling for baseline symptom severity, gender, DUP and premorbid adjustment.			disorder, delusional disorder, bipolar disorder - No substance misuse, head injury or organic disorder judged as primary cause of psychotic symptoms				Decentration). Addition MAS-A scores to predictive models of negative symptoms explained 62% of variance at 6 months and same model explained 38% of variance at 12 months.

Table 1.17: Summary of record for the Scotland sample 4 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
Breustedt (2017), Glasgow, UK (Thesis)	Examines feasibility of measuring and the associations between autobiographical memory,	Repeated Measures	None	Inpatients from local psychiatric wards diagnosed with a SSD - No people with recognised cognitive deficits (dementia, learning disability, history	PANSS – original factor structure	MAS-A	- Autobiographical Memory Interview - Brain Injury Rehabilitation Trust Memory & Information	Significant correlations between Decentration and total metacognition with PANSS-NS. No other directly

	metacognitive functioning, and executive functioning in individuals experiencing acute psychosis.			of head injury with loss of consciousness) - No intoxication with alcohol or illicit substances at time of testing or preceding 24 hours - No patients with inadequate command of English - No patients unable to give informed consent.			Processing Battery story recall task - Hayling Sentence Completion Test - Brenner Scale of Clinical Change in Schizophrenia - Questionnaire on the Process of Recovery	relevant analyses undertaken.

Table 1.18: Summary of records for the Spain sample 1 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
Inchausti et al. (2017a), Spain (Journal article)	Examines the feasibility and effectiveness of a psychotherapy group based on	Pre-post design	16 group sessions of MOSST.	Spanish speaking outpatients from mental healthcare services aged 18-65 years meeting ICD-10 criteria for schizophrenia,	PANSS – Original factor structure	MAS-A – rated using data obtained via the Spanish	- PSP - Beck Depression Inventory (2nd version; BDI-II)	No directly relevant analyses undertaken.

	metacognitive-oriented social skills training (MOSST) for people with schizophrenia.			schizoaffective disorder, or delusional disorder, who demonstrated capacity to consent and social engagement problems and poor participation in social activities. - No antipsychotic medication changes (2 months) - No concomitant substance abuse - No moderate to severe learning disabilities or developmental disorders - No major neurological illness - No impaired intellectual functioning WAIS, fourth edition (WAIS-IV), IQ <70)		adaptation of the MAI	- Beck Anxiety Inventory (BAI)	

Table 1.19: Summary of records from the Spain sample 2 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Inchausti et al. (2017b), Spain (Journal article)	Compares the effectiveness of a group intervention based on MOSST vs Social Skills Training (SST) in outpatients with a SSD	Single-Blind RCT with a 6 month follow up.	16 group sessions of MOSST vs SST in addition to standard care over 4 months.	Partially hospitalised outpatients aged 18-65 receiving psychosocial rehabilitation meetings ICD-10 criteria for schizophrenia, schizoaffective disorder, or delusional disorder who demonstrated capacity to consent and difficulties with social engagement and poor participation in social activities. - No antipsychotic medication changes (2 months) - No concomitant substance abuse	PANSS – Spanish adaptation, original factor structure	MAS-A - rated using data obtained via the Spanish adaptation of the MAI	- Social and Occupational Functioning Assessment Scale - Beck Depression Inventory (BDI)-II (Spanish adaptation) - BAI (Spanish adaptation) - Self-report of enjoyableness, usefulness, and effect of daily social functioning (5-point scale)	No directly relevant analyses undertaken.

				- No moderate to severe learning disabilities or developmental disorders - No major neurological illness - No impaired intellectual functioning (WAIS-IV, IQ<70)				

Table 1.20: Summary of records from the Turkey sample 1 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Tas et al. (2012b), Turkey (Journal article; see also conference abstract, Tas et al., 2012a; and thesis, Tas, 2013)	Examines relationship between intrinsic motivation and metacognition and their impact on learning potential in patients with symptomatically	Pre-training – post-training experimental design	Training procedure based upon cognitive remediation	Patients meeting DSM-IV criteria for schizophrenia and remission criteria of the Schizophrenia Working Group (Andreasen et al., 2005)	PANSS – used to rate symptomatic remission – analysed using original factor structure (confirmed via	MAS-A – derived from IPII interviews which were translated into Turkish	- WMS-III – Memory Quotient subscale - IPII - Intrinsic Motivation Inventory - WCST	All MAS-A subscales significantly correlated with each other. All subdomains of metacognition also correlated with all subdomains of intrinsic

	remitted schizophrenia				personal communication)			motivation, except interest and enjoyment. In regression analyses, inclusion of mastery, but not measures of intrinsic motivation, significantly predicted learning style.

Table 1.21: Summary of records for the Turkey 2 sample dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
Tas et al. (2014), Turkey (Journal article)	Examined metacognitive abilities of people with schizophrenia and bipolar	Cross-Sectional	None	Patients from the psychosis and affective disorders units from Celal Bayer University meeting DSM-IV criteria for schizophrenia	PANSS – analysed using original factor structure (confirmed via	MAS-A – derived from IPII interviews which were translated into Turkish	- Hamilton Depression Rating Scale - Young Mania Rating Scale	No significant correlations between PANSS-NS and MAS-A subscales. MAS-A

	disorder and compared to levels of neurocognition			- No medication changes (3 months) - No hospitalisations (6 months) - No neurological disorder e.g. comorbidities e.g. epilepsy - No drug and alcohol abuse	personal communication)		- WMS-III – Memory Quotient subscale - WCST - IPII – Turkish Translation	subscales all significantly correlated with each other. No other directly relevant analyses undertaken.

Table 1.22: Summary of records for the Turkey sample 3 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
Aydin et al. (2016), Manisa, Turkey (Journal article)	Explores association between attachment, trauma and metacognition in people with schizophrenia.	Cross-sectional	None	Outpatients from the psychiatric unit of local university meeting DSM-IV-TR criteria for schizophrenia. - No medication changes (3 months)	PANSS – original factor structure	IPII translated to Turkish to be used to rate MAS-A.	- Experience in Close Relationships – Revised - My memories of upbringing short version.	No directly relevant analyses undertaken

				- No hospitalisation (6 months) - No substance use disorder, mental retardation, or dementia - No-one over age 65.			- CTQ – 28 item version.	

Table 1.23: Summary of records from the USA sample 1 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Lysaker et al. (2005), USA	Examines relationship between metacognition and neurocognition, positive, negative and disorganised symptoms, quality of life, and awareness of illness in people	Cross-sectional	None delivered as part of this research although data obtained from participants en rolled in a larger study seeking to develop CBT targeting	Outpatients from the psychiatry service of a Veterans' Affairs (VA) Medical Centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No hospitalisations (1 month) - No medication changes (1 month)	PANSS – a-priori selected 6 items to analyse: 3 positive symptoms (hallucinations, delusions, and suspiciousness), 3 negative symptoms (blunted affect,	MAS-A – Decentration excluded from analysis	- Hopkins Verbal Learning Test (HVLT) - WCST - WAIS (Visual Reproduction, Digit Symbol and Vocabulary subtests) - SUMD	Significant relationship between SR, UOM, and Mastery with emotional withdrawal, but not with blunted affect or disturbance of volition. Significant correlations between these

	with schizophrenia.		working function in schizophrenia	- No housing changes (1 month) - No mental retardation - No active substance abuse	emotional withdrawal and disturbance of volition) and one general symptom (depression)		- Quality of Life Scale (QOL) - IPII	same subscales with each other.

Table 1.24: Summary of records for the USA sample 2 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Buck et al. (2012), USA (Journal article; see also conference abstract, Buck et al., 2011)	To explore the relationship between mastery and jumping to conclusions in people with schizophrenia, controlling for delusions and neurocognitive deficits.	Cross-sectional	None	Outpatients from a VA Medical Centre or community mental health centre meeting DSM-IV criteria for a SSD - No medication changes (30 days) - No hospitalisations (30 days) - No housing changes (30 days)	PANSS: Delusions item only reported, analysed with Bell et al. (1994) factor structure (confirmed via personal communication)	MASA-A - Mastery	- IPII - Beads Task - HVLT - WSCT	No directly relevant analyses undertaken.

				- No active substance dependence - No chart diagnosis of mental retardation				
Davis et al. (2011), USA (Journal article)	Explores the relationship between mastery and therapeutic alliance in people with schizophrenia.	Repeated measures	Participants were randomly allocated to a 26-week course of CBT or supportive therapy for a vocational rehabilitation research study	Outpatients from a VA Medical Centre or community mental health centre who met DSM-IV criteria for schizophrenia or schizoaffective disorder, who were willing to engage in vocational rehabilitation and had then attended at least 7 sessions of psychotherapy and completed alliance ratings for at least 3 sessions - No psychotropic medication changes (1 month) - No psychiatric hospitalisations (1 month) - No chart diagnosis of mental retardation	PANSS: total score used as an indicator of symptom severity, analysed with Bell et al. (1994) factor structure (confirmed via personal communication)	MAS-A - Mastery	- The Working Alliance Inventory – Short Version – Client Form - IPII - WAIS-III (Block design subtest) - HVLT	Found individuals grouped by their level of mastery had significantly different PANSS-NS scores. No other directly relevant analyses undertaken.

				- No chart diagnosis of active substance abuse/dependence				
de Jong et al. (2014), USA (Journal article)	Examines whether treatment condition and metacognition are predictive of job satisfaction in people with schizophrenia.	Repeated measures design	None delivered as part of this research, although data came from a study examining the benefits of CBT for job performance	Outpatients receiveng services from a VA Medical Centre or community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder. - No medication changes (1 month) - No hospitalisations (1 month) - No housing changes (1 month) - No comorbid neurological disorder - No presence of mental retardation	PANSS – positive and negative subscales analysed (confirmed via personal communication)	MAS-A	- IPII - Weekly Self-Evaluation Form	Negative symptoms didn't play a significant role in the relationship between metacognition and treatment effectiveness for either work satisfaction and consistency with satisfaction.
Fridberg et al. (2010), USA (Journal article)	Examines relationship between intrusion errors and self-reflectivity,	Cross-sectional	None delivered as part of this research, although data came from	Outpatients from psychiatry services in a VA Medical Centre or a community mental health centre meeting DSM-IV criteria for	PANSS – analysed positive, negative, and disorganised symptoms	MAS-A – added two questions to the interview used to rate the MAS-A (the IPII)	- HVLT - IPII - Conners' Continuous	Significant correlation between SR and PANSS-NS. No other directly

	positive and disorganised symptoms, and executive functioning in people with schizophrenia.		participants enrolled in a study investigating CBT targeting working function in schizophrenia.	schizophrenia or schizoaffective disorder. - No medication changes (1 month) - No hospitalisations (1 month) - No housing changes (1 month) - No mental retardation - No active substance abuse	according to Bell et al. (1994) factor structure	which asked how much their illness was affected by others and how much others have been affected by their illness to offer opportunity to demonstrate decentration. Interested in SR only for the purposes of the study.	Performance Test II (CPT-II) - WCST - WAIS-III (Vocabulary subtest)	relevant analyses undertaken.
Luedtke et al. (2012), USA (Letter to the editor)	Examines whether affect recognition and self-reflectivity were related to accuracy of self-appraisal of performance in a work programme.	Cross-sectional	Participants were already taking part in a 26 week work placement as part of a RCT of the effects of cognitive therapy on	Adults with SCID-confirmed diagnoses of schizophrenia or schizoaffective disorder - Receiving support as part of the trial - Completed at least one week of work	PANSS	MAS-A - SR	- IPII - Bell-Lysaker Emotion Recognition Task (BLERT) - Work Behaviour Inventory - Participant self-report of	No directly relevant analyses undertaken.

			work outcomes.				work (5 point likert item)	
Lysaker et al. (2007), USA (Journal article)	Examines association between different components of metacognition and neurocognition in people with schizophrenia, controlling for symptoms and neurocognition.	Cross-sectional	None as part of this, although data came from participants recruited for a larger study examining CBT targeting work function in people with schizophrenia	Outpatients from the psychiatry service of a VA Medical Centre or community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder. - No hospitalisations (1 month) - No medication changes (1 month) - No housing changes (1 month) - No mental retardation - No active substance abuse	PANSS – used van der Gaag et al. (2006) factor structure for analysis.	MAS-A – grouped participants based on whether they received a score of 4 or more, or 2 or more respectively on SR and Decentration	- IPII – with additional questions about how the participant's illness has been affected by others and how much others have been affected by their illness as an additional opportunity to portray decentration. - WAIS-III (Vocabulary, Block Design, Arithmetic and Digit Symbol subtests) - WMS-III	Significant relationship between SR and PANSS-NS, but not Decentration. When clustering participants based on their SR/ Decentration levels, there were significant differences across groups for SR, Decentration and PANSS-NS. No other directly relevant analyses undertaken.

							- WCST - BLERT	
Lysaker et al. (2008), USA (Journal article)	Examines relationship between metacognition and subtypes of executive functioning in individuals with schizophrenia	Cross-sectional study	None delivered as part of this research, however data obtained from participants who data was collected across two studies; the IPII data was part of an intake assessment for a study of the effects of cognitive therapy, and the Delis-Kaplan Executive Function System (DKEFS), PANSS	Male outpatients from a VA Medical Centre and a community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No hospitalisations (prior month) - No medication changes (prior month) - No mental retardation - No active substance abuse	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- The DKEFS - IPII - BCIS	No directly relevant analyses undertaken.

			and BCIS were administered in a study of the correlates of anxiety in schizophrenia.					
Lysaker et al. (2010a), USA (Journal article)	Examines the association between metacognition and social cognition for people with schizophrenia, controlling for symptoms and neurocognition.	Cross-sectional	None delivered as part of this research, although participants recruited from a larger study examining the effects of cognitive therapy.	Outpatients from a VA Medical Centre or a community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No hospitalisations (1 month) - No medication changes (1 month) - No housing changes (1 month) - No active substance dependence (chart review) - No history of mental retardation (chart review)	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A – did not analyse the decentration subscale	- IPII - Thematic Appreception Test - Social Cognition and Object Relations Scale (SCORS) - HVLT - WCST	No significant relationship between total metacogniton or subscales with PANSS-NS. Significant correlations between MAS-A subscales. Negative symptoms did not significantly influence relationship between MAS-A and SCORS indices.
Lysaker et al. (2010b),	Examines whether the relationship between	Cross-sectional	None as part of this research however	Outpatients from a VA Medical Centre or community mental health	PANSS – analysed positive and negative	MAS-A - Mastery	- QOL - IPII	No significant relationship between Mastery

USA (Journal article)	neurocognition and social contact, and the capacity for social relatedness, is mediated by mastery in persons with schizophrenia.		participants had been enrolled in a study of the effects of CBT on work outcomes in schizophrenia.	centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No medication changes (30 days) - No hospitalisations (30 days) - No housing changes (30 days) - No active substance dependence - No chart diagnosis of mental retardation	subscales with Bell et al. (1994) factor structure		- WAIS-III (Digit Symbol, Vocabulary, Visual Reproduction subtests) - HVLT - WCST	and PANSS-NS. Negative symptoms didn't significantly influence relationship between mastery and social function variables.
(Lysaker et al., 2011g), USA (Journal article; see also conference abstract, Lysaker et al., 2011c)	Examines relationship between metacognition and neurocognition, negative and disorganised symptoms, emotional distress and history of childhood sexual trauma for people	Cross-sectional	None delivered as part of this research, although data came from participants who were enrolled in a study of the effects of CBT on work	Outpatients from a VA Medical Centre or community mental health centre meeting DSM-IV criteria for schizophrenia or a SSD - No medication changes (30 days) - No hospitalisations (30 days) - No housing changes (30 days)	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A - SR; dichotomised groups based on score of "4" or above, versus below 4	- IPII - BLERT - WCST - WAIS-III - HVLT - CPT-II - Trauma assessment for adults – brief revised version	Relationship between SR and self-appraisal of work behaviour not significantly influenced by negative symptom scores

	with schizophrenia.		outcomes in schizophrenia.	- No active substance dependence - No chart diagnosis of mental retardation				
Lysaker et al. (2011h), USA (Journal article)	Examines relationship between mastery and observable measures of functional competence, controlling for symptoms and executive function, in people with schizophrenia.	Cross-sectional	None as part of this research however participants had previously participated in a study of the effects of cognitive therapy on outcome in schizophrenia.	Outpatients from a VA Medical Centre or a community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder.	PANSS – analysed positive and negative subscales with Bell et al. (1994) factor structure	MAS-A - Mastery	- IPII - WCST - UPSA	Negative symptoms didn't significantly influence relationship between functioning and metacognition.
Nabors et al. (2014), USA (Journal article)	Explores variables related to the ability to reject stigma including self-stigma, self-esteem, positive and negative symptoms,	Cross-sectional	None	Outpatients from a VA Medical Centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No hospitalisations (1 month)	PANSS – analysed with Bell et al. (1994) factor structure (did not analyse hostility subscale)	MAS-A – interested in the total score only for the purposes of this study	- ISMIS - RSES - IPII	Negative symptoms didn't influence the statistical significance of the relationship between metacognition and stigma resistance.

	cognitive disorganisation, emotional discomfort and metacognitive capacity in individuals with schizophrenia.			- No housing changes (1 month) - No medication changes (1 month) - No evidence of organic brain syndrome or mental retardation				

Table 1.25: Summary of records from the USA sample 3 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Hamm et al. (2012), USA (Journal article)	Examines the relationship between metacognition and affect recognition with current and prospective symptoms, controlling for	Repeated measures design	None	Outpatients from a VA Medical Centre or a community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No medication changes (30 days)	PANSS – analysed positive, negative and disorganised symptoms with Bell et al. (1994) factor structure (confirmed via	MAS-A – analysed total score only	- IPII - BLERT - WCST	Significant correlation between MAS-A Total scores and PANSS-NS at baseline and 6 months. MAS-A and negative symptom baseline scores significantly

	neurocognitive impairment in people with schizophrenia. Specifically interested in whether deficits in metacognition and affect recognition would be related to the presence of negative and disorganised symptoms, and investigated the relationship with positive symptoms on an exploratory basis.			- No hospitalisations (30 days) - No housing changes (30 days)	personal communication)			predictied negative symptoms at 6 months, controlling for other factors including WCST score.
Leonhardt et al. (2014), USA (conference abstract)	Examines whether mental state decoding, mental state reasoning and metacognitive	Appears cross-sectional	None reported	Adults with a SSD in a non-acute phase of disorder.	PANSS – analysed with Bell et al. (1994) factor structure (confirmed via	MAS-A	- the Eyes and the Hinting Test - BLERT	Insufficient information regarding potentially relevant

	capacity were predictive of emotion recognition in a social interaction task for adults with schizophrenia.				personal communication)			analyses undertaken.
Lysaker (2011), USA (conference abstract)	Examines whether metacognitive capacity predictive of insight in people with schizophrenia.	Cross-sectional	None	Adults with a SSD in a post-acute phase of illness living in the community	PANSS – analysed with Bell et al. (1994) factor structure (confirmed via personal communication)	MAS-A	- WCST - Hinting Test - BLERT - SUMD	Insufficient details on potentially relevant analyses reported.
Lysaker et al. (2011b), USA (conference abstract)	Explores relationship between MAS-A Self-reflectivity and MAS-A Other and its relationship with theory of mind and function in	Cross-sectional	None	Adults with a SSD in a non-acute phase of illness	PANSS – analysed with Bell et al. (1994) factor structure.	MAS-A	- BCIS - BLERT - Hinting Test - WAIS-III (Picture Arrangement subtest) - QOL	Insufficient details on relevant analyses reported

	people with schizophrenia.							
(Lysaker et al., 2011j), USA (conference abstract)	Examines relationship between mastery (categorised into three groups of different capabilities) and daily functioning.	Cross-sectional	None	Outpatient adults with a SSD in a non-acute phase who were participating in active treatment	PANSS – analysed with Bell et al. (1994) factor structure (confirmed via personal communication)	MAS-A	"Participants in all three groups completed assessments of coping preference, insight, self-esteem, anxiety and neurocognition."	No directly relevant analyses apparent.
Lysaker et al. (2012), USA (Journal article)	Examines whether metacognition and social cognition are separate constructs through factor analysis of people with schizophrenia. Particular interest in relationship of metacognition and social cognition to negative and	Cross-sectional	None	Outpatients from a VA Medical Centre or a community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder. - No medication changes (30 days) - No housing changes (30 days) - No hospitalisations (30 days)	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- BLERT - Hinting Task - Reading the mind in the eyes test - IPII - BCIS - QOL - WCST - WAIS-III	Factor analytical structure of metacognitive constructs (BCIS and MAS-A total) not significantly related to negative symptoms scores.

	cognitive symptoms.			- No active substance dependence - No chart diagnosis of intellectual disability				

Table 1.26: Summary of records for the USA sample 4 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Firmin et al. (2017), USA (Journal article)	Exploring whether metacognition and fearing negative evaluation from others contribute to stigma resistance for people with schizophrenia.	Cross-sectional	None	Outpatients from an urban, VA Medical Centre or community mental health centre with a SCID confirmed diagnosis of schizophrenia or schizoaffective disorder.	PANSS – analysed with Bell et al. (1994) factor structure (confirmed via personal communication)	MAS-A – grouped participants based on high, intermediate or low levels of metacognition based on a two-step cluster analysis.	- IPII - ISMIS – Stigma resistance sub-scale	No directly relevant analyses undertaken.
Kukla et al. (2013), USA (Journal article; see also	Examines relationship between self-reported recovery	Cross-sectional	None delivered as part of this research, although data	Outpatients aged 18 or older from a VA Medical Centre or a community mental health centre	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A SR and Decentration only	- IPII - RAS	Relationships between metacognition (based on

conference abstract, Kukla & Lysaker, 2013)	and metacognitive capacities controlling for severity of psychiatric symptoms in people with schizophrenia, including an exploration of the specific contribution of negative symptoms.		came from participants who were taking part in a study of the Illness Management and Recovery program. Data analysed was collected prior to intervention.	meeting DSM-IV criteria for schizophrenia or schizoaffective disorder. - No severe cognitive dysfunction (cognitive screen) - No physical health condition which would limit participation in an 18 month study.				participants characterised by levels of SR and Decentration) and recovery remained significant after controlling for negative symptoms
Minor et al. (2015a), USA (Journal article)	Examined association between positive emotion, negative emotion, and social word use, with symptoms, metacognition and general functioning in a	Cross-sectional	Data was obtained from baseline scores of participants who took part in an RCT examining the impact of Illness Management and Recovery.	Outpatients with confirmed DSM-IV diagnoses of schizophrenia or schizoaffective disorder with complete baseline data for speech, symptoms, metacognition and functioning. - No one below age 18 - No severe cognitive impairments	PANSS – analysed reality distortion, negative and disorganised subscales with Bell et al. (1994) factor structure	MAS-A	- IPII - Linguistic Enquiry Word Count - QOL – Abbreviated Version	No directly relevant analyses undertaken.

	schizophrenia cohort.							

Table 1.27: Summary of records on the USA sample 5 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Hasson-Ohayon et al. (2018a), Indiana, USA, (Journal article; see also conference abstract, Hasson-Ohayon et al., 2018b)	Examined, through network analysis, whether certain symptoms, neurocognitive domains, or aspects of social cognition and metacognition played a more central role than others in people with schizophrenia.	Cross-sectional study	Not for this study however data obtained from RCT evaluating the impact of cognitive remediation on work outcomes. Only baseline/pre-intervention measures utilised in this study.	Outpatients from a Veteran's Affairs Medical Centre and a community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No hospitalisations (30 days) - No medication changes (30 days) - No housing changes (30 days)	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- IPII - Hinting Task - BLERT - Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) - Social Attributions Test – Multiple Choice (SAT-MC)	MAS-A subscales have high strength in a network of metacognition, neurocognition, symptoms and social cognition variables. Negative symptoms were not ranked high on betweeness, closeness and strength.

				- No documented developmental disability (medical record) - No documented organic brain disease (medical record)			- Picture sequencing task	
James et al. (2016), USA (Journal article)	Examines whether positive self-appraisal and higher metacognition are necessary for increased social functioning, controlling for psychopathology, neurocognitive functioning and social cognition in persons with schizophrenia.	Cross-sectional	None delivered as part of this research, although data came from participants enrolled in a study examining the role of cognitive remediation on work outcomes in schizophrenia	Outpatients from a VA Medical Centre meeting DSM-IV or DSM-IV-TR criteria for schizophrenia or schizoaffective disorder. - No medication changes (30 days) - No hospitalisations (30 days) - No housing changes (30 days) - No active substance dependence - No documented intellectual disability	PANSS – total scores and positive and negative symptom sub-scores analysed with Bell et al. (1994) factor structure (confirmed via personal communication)	MAS-A	- IPII - MATRICS - Beck Hopelessness Scale - RAS - Rosenberg Self-Esteem Scale (RSES) - BLERT - Hinting Task - QOL	Negative symptoms did not significantly influence relationship between metacognition and social functioning, and social relatedness and profiles of metacognition and self-appraisal, and metacognition and social contact.
James et al. (2018), USA (Journal article)	Examined the frequency and co-occurrence of emotion	Cross-sectional study	None as part of this research, however data obtained from	Outpatients from a VA medical centre meeting DSM-IV-TR criteria for	PANSS – analysed positive, negative and emotional	MAS-A	- BLERT - the Hinting Task - SAT-MC	Negative symptoms not found to be a significant covariate in the relationship

	recognition and social inference deficits and examined the relationship between neurocognition, metacognition and social cognition and emotion recognition and social inference, controlling for positive, negative and emotional discomfort symptoms in people with schizophrenia.		a larger RCT investigating the effect of cognitive remediation on work outcomes in schizophrenia.	schizophrenia or schizoaffective disorder. - No mediation changes (30 days) - No housing changes (30 days) - No inpatient treatment (30 days) - No documented intellectual disability - No documented active substance dependence	discomfort symptoms (according to Bell et al., 1994 factor structure)		- IPII - MATRICS Consensus Cognitive Battery (MCCB)	between metacognition and social cognition.
Leonhardt et al. (2015), USA (Journal article)	Explores whether metacognitive awareness is a risk factor for development of distress, greater	Cross-sectional	None delivered as part of this research, although data came from baseline	Outpatients rom a local VA Medical Centre or community mental health centre meeting DSM criteria for a SSD (confirmed by	PANSS – analysed with Bell et al. (1994) factor structure – confirmed via personal	MAS-A	- Posttraumatic Stress Disorder Checklist – Specific Subscale - IPII	Significant relationship between SR, Decentration and Mastery and PANSS-NS for individuals

	symptom severity and is associated with self-reports of history of childhood sexual abuse among adults with schizophrenia.		assessments of participants who then took part in a study of CBT and work outcome.	SCID, assumed DSM-IV-TR criteria). - No medication changes (30 days) - No hospitalisations (30 days) - No housing changes (30 days)	communication (hostility subscale not reported)			who reported childhood sexual abuse only, and no significant relationships between MAS-A other and PANSS-NS. No significant difference between correlation coefficients of groups who did/didn't report childhood sexual abuse on test between two independent correlation coefficients.
Luther et al. (2016a), USA (Journal article)	Examines relationship between metacognition and prospective motivation,	Repeated Measures Design	None	Outpatients from a VA Medical Centre or a community mental health centre meeting DSM-IV-TR criteria for schizophrenia or schizoaffective disorder.	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A – analysed the total score for the purpose of this study	- IPII - QLS - Temporal Experiences of Pleasure Scale	Reduced baseline motivations significantly related to increased baseline negative symptoms and

	controlling for baseline motivation, demographics, anticipatory pleasure, and antipsychotic medication dose in individuals with a SSD			- No hospitalisations (30 days) - No housing changes (30 days) - No medication changes (30 days) - No active substance dependence (chart review) - No developmental disability (chart review)				lower metacognition. Decreased motivation at 6-month follow up also associated with decreased baseline motivation, anticipatory pleasure and metacognition amongst other factors. Metacognition was a significant contributor to a model predicting prospective motivation.
Lysaker et al. (2013b), USA (conference abstract)	Examines relationship between metacognition and social cognition and	Cross-sectional	None	Adults with schizophrenia in a non-acute phase of illness	PANSS – analysed with Bell et al. (1994) factor structure (confirmed via	MAS-A	- BLERT - Hinting Test - Brüne Mental State Attribution Task - SAT-MC	Significant relationship between total metacognition and PANSS-NS. No other

	neurocognition in people with schizophrenia, controlling for symptoms.				personal communication)		- Mayor-Salovey-Caruso Emotional Intelligence Test (MSCEIT) - MATRICS - QOL	directly relevant analyses apparent.
Lysaker et al. (2013c), USA (Journal article)	Examines the role of stigma, social cognition and metacognition in the confluence and lack of confluence of depression and insight in schizophrenia, controlling for symptom severity and neurocognitive capacity.	Cross-sectional	None as part of this research however participants were recruited for a larger survey of the effects of cognitive remediation on work outcome.	Outpatients from a VA Medical Centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No medication changes (1 month) - No hospitalisations (1 month) - No housing changes (1 month) - No active substance dependence	PANSS – analysed positive and negative symptom subscales with Bell et al. (1994) factor structure	MAS-A - Mastery - grouped participants based on their scores	- IPII - SUMD - ISMIS - Hinting Task - BLERT - Toronto Alexithymia Scale - MATRICS	Negative symptoms didn't significantly alter the relationship between metacognition and depressive symptoms and insight profiles. No other directly relevant analyses undertaken.
(Lysaker et al., 2015a), USA	Examined relationship between	Repeated measures design	Participants were enrolled	Adults with a SCID confirmed diagnosis of a SSD	PANSS – analysed with Bell et al. (1994) factor	MAS-A - Mastery (from baseline assessment)	- MATRICS	Participants, grouped by mastery, had

(conference abstract)	metacognitive mastery and negative symptoms in people with schizophrenia.		in vocational rehabilitation.		structure (confirmed via personal communication)			significantly different levels of negative symptoms across four time points (with the low mastery group having higher negative symptoms). Mastery continued to be significantly related to negative symptoms at 9 and 17 weeks even when controlling for the previous NS assessment. Insufficient information given about remaining analyses.
Lysaker et al. (2015c), USA (Journal article)	Examined whether metacognitive deficits were predictive of	Repeated measures design	Participants were enrolled as part of a larger RCT	Outpatients from a VA Medical Centre meeting DSM-IV criteria for schizophrenia or	PANSS-NS analysed with Bell et al. (1994) factor structure	MAS-A – interested in total metacognition	- IPII - MATRICS - BLERT - RAS	When participants grouped by metacognition level (low, moderate,

	negative symptoms, controlling for neurocognition, affect recognition and defeatist beliefs in people with schizophrenia.		examining work outcomes for persons with schizophrenia and were randomised to a work place and either a) supportive psychotherapy, b) CBT, or c) cognitive remediation plus CBT	schizoaffective disorder, who had completed two of three scheduled negative symptoms assessments post baseline - No hospitalisations (30 days) - No housing changes (30 days) - No medication changes (30 days) - No history of substance dependence - No history of traumatic brain injury - No intellectual disability		for the purposes of this study		high), the low metacognition group had higher overall negative symptoms. Participants with low MAS-A scores at baseline had a trajectory of worsening negative symptoms over time. Results were consistent across all treatment groups.
Minor and Lysaker (2014), USA (Journal article)	Examined relationship between symptoms, particularly disorganised symptoms, and neurocognition, social cognition	Cross-sectional	Data obtained from baseline scores of participants who took part in a larger RCT examining the role of cognitive	Outpatients from a VA Medical Centre meeting DSM-IV-TR criteria for schizophrenia or schizoaffective disorder who had completed baseline scores for symptoms, neurocognition,	PANSS – analysed reality distortion, negative and disorganised symptom subscales with Bell et al. (1994) factor structure	MAS-A	- MATRICS - BLERT - Hinting Task - SAT-MC - IPII	Significant negative correlation between total Metacognition, SR and Mastery, and PANSS-NS. UOM and Decentration not significantly correlated. No other directly

	and metacognition in people with schizophrenia		remediation on work outcomes in schizophrenia	social cognition and metacognition - No medication changes (30 days) - No housing changes (30 days) - No hospitalisations (30 days) - No active substance dependence - No documented intellectual disability				relevant analyses undertaken.
Minor et al. (2015c), USA, (Journal article; see also conference abstract, Minor et al., 2015b)	Examines relationship between disorganisation and neurocognition, social cognition and metacognition and whether disorganisation moderated relationship between these	Cross-sectional	Data was obtained from baseline scores of participants who took part in an RCT focusing on the effects of cognitive remediation in serious mental illness.	Outpatients from a VA Medical Centre meeting DSM-IV-TR criteria for schizophrenia or schizoaffective disorder - No medication changes (30 days) - No housing changes (30 days) - No hospitalisations (30 days) - No active substance dependence	PANSS – only analysed the conceptual disorganisation item	MAS-A	- MATRICS - MSCEIT - BLERT - Hinting Task - SAT-MC - IPII	No directly relevant analyses undertaken.

	variables in a schizophrenia sample			- No documented intellectual disability				
Minor et al. (2019), USA (Journal article)	Examines whether a measure of speech detecting disorganisation was related to neurocognition, social cognition, and metacognition in schizophrenia and compared this to a clinician-rated measure of disorganisation.	Cross-sectional	Data was obtained from baseline scores of participants taking part in a RCT on cognitive remediation	Outpatients from a VA Medical Centre meeting DSM-IV-TR criteria for schizophrenia or schizoaffective disorder - No medication changes (30 days) - No hospitalisations (30 days) - No documented intellectual disability - No active substance dependence	PANSS – disorganised subscale of the Bell et al. (1994) factor structure	MAS-A	- IPII - Coh-Metrix 3.0 - MATRICS - MSCEIT - BLERT - Hinting Task - SAT-MC	No directly relevant analyses undertaken.
Schnakenberg et al. (2016), Indiana, USA (Journal article)	Examines association between cannabis use and neurocognition and metacognition in people with schizophrenia.	Cross-sectional	Not as part of this research however participants took part in a larger investigation of the effects of cognitive	Outpatients from a psychiatry service of a VA Medical Centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No hospitalisations (1 month)	PANSS – analysed with Bell et al. (1994) factor structure – confirmed via personal communication (excluding the emotional	MAS-A	- MCCB - Addiction Severity Index - Wechsler Abbreviated Scale of Intelligence	Groups clustered based on composite scores of metacognition, neurocognition and cannabis use did not display significantly different levels of

			remediation on work outcome	- No housing changes (1 month) - No medication changes (1 month) - No intellectual disability - No chart diagnosis of mental retardation - No substance dependence (excluding tobacco)	discomfort subscale)			negative symptoms.

Table 1.28: Summary of records for the USA sample 6 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Francis et al. (2017), USA (Journal article)	Examines relationship between the mPFC and metacognition in people with early phase psychosis.	Cross-sectional	None	Outpatients aged 18-35 meeting DSM-IV-TR criteria for schizophrenia, schizophreniform disorder or schizoaffective disorder, who were in first five years of illness onset.	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- IPII - functional Magnetic Resonance Imaging (MRI)	Relationship between the medial Pre-Frontal Cortex and metacognitive capacity was not better accounted

				- No medication changes (1 month) - No significant affective symptoms (1 month, patients with schizoaffective disorder) - Clinically stable (CGI-Severity <4) - No diagnosis of substance abuse or dependence (within 3 months of testing) - no medical record documented mental retardation - No contraindication to scanning procedures				for by the relationship between metacognition and negative symptoms
Leonhardt et al. (2017a), USA (conference abstract)	Explores the link between integration difficulties at a basic level and at the level of self-reflectivity and insight in	Appears cross-sectional	None reported	Adults with FEP	PANSS – analysed with Bell et al. (1994) factor structure (confirmed via personal communication)	MAS-A	- Electro-encephalogram (EEG) collected using an Auditory Steady State Response - Brief Assessment of	No directly relevant analyses apparent.

	individuals with FEP						Cognition in Schizophrenia	
Mehdiyoun et al. (2015), USA (conference abstract)	Examines relationship between metacognition and internalised stigma in people with FEP	Cross-sectional		Persons in the Prevention and Recovery Centre for Early Psychosis service who were diagnosed with a psychotic disorder	PANSS	MAS-A	- IPII - ISMI	Insufficient details on relevant analyses reported
Vohs et al. (2014), USA (Journal article)	Examined differences in metacognition, symptoms and social cognition in participants with first episode and prolonged psychosis versus a psychiatric control group	Cross-sectional	None delivered as part of this research, although the prolonged psychosis group were recruited through an ongoing trial evaluating cognitive therapy and vocational rehabilitation.	Outpatients aged 18-65 from the Prevention and Recovery Centre for Early Psychosis (PARC) and outpatients from a VA Medical Centre and a local community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder, and psychosis not otherwise specified in the FEP group only - No active substance dependence (3 months)	PANSS – analysed the positive, negative and disorganised subscales with Bell et al. (1994) factor structure	MAS-A	- IPII - BLERT - Hinting Task - Eyes Test	PANSS-NS significantly correlated with MAS-A total score and all subscales except Decentration

				- No history of mental retardation				
Vohs et al. (2015b), USA (Journal article; see also conference abstract, Vohs et al., 2015a)	Examine the neuroanatmical correlates of metacognition in people with FEP	Cross-sectional	None	Outpatients aged 18-35 meeting DSM-IV criteria for a SSD within first five years of illness onset - No active substance dependence (3 months) - No IQ <70 - No MRI incompatibility	PANSS-NS with Bell et al. (1994) factor structure	MAS-A	- Hollingshead Two Factor Index of Social Position - IPII - MRI	No directly relevant analyses undertaken.
Vohs et al. (2015c), USA (Journal article)	Examines relationship between insight and metacognitive capacity and their relationships with social cognition, neurocognition, and symptoms in individuals with FEP	Cross-sectional	None	Outpatients from a community mental health centre clinic for individuals in early stages of psychotic illness (up to 5 years from initial treatment) meeting DSM-IV criteria for a SSD - No active substance dependence (3 months) - No IQ < 70	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A – Decentration excluded from report of analysis	- Hollingshead-Redlich Scale - IPII - SUMD - BCIS - BLERT - Hinting Task - WCST - WAIS-IV (Vocab and Matrix Reasoning subtests)	UOM, Mastery and total metacognition significantly correlated with PANSS-NS. SR subscale appears not significantly correlated as not reported. No other directly relevant analyses conducted.

Table 1.29: Summary of records for the USA sample 7 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Bonfils et al. (2016), USA (Journal article	Examines association between emotional awareness, self-esteem, hope and metacognition in individuals diagnosed with a SSD	Cross-sectional	None delivered as part of this research, although data came from baseline assessment of participants later involved in an investigation of Narrative Enhancement and Cognitive Therapy.	Outpatients receiving services from a VA Medical Centre or urban community mental health centre meeting DSM-4 criteria for a SSD - No medication changes (1 month) - No hospitalisations (1 month) - No substance dependence (chart review)	PANSS – positive and negative symptoms analysed with Bell et al. (1994) factor structure (confirmed via personal communication)	MAS-A	- Difficulties in Emotion Regulation Scale - RSES - The Beck Hopelessness Scale	Significant correlations between MAS-A subscales. Negative symptoms a significant covariate in moderating analyses between SR and both self-esteem and hopelessness.
Bonfils et al. (2018), USA (Journal article;	Examines associations between distress	Cross-sectional	None delivered as part of this research,	Outpatients from a VA Medical Centre or urban community mental health	PANSS – analysed positive and negative	MAS-A - SR	- QOL - Distress Tolerance Scale	Significant correlation between SR and PANSS-NS.

see also conference abstract, Bonfils et al., 2017)	tolerance and empathy and whether this is moderated by metacognitive self-reflectivity in people with schizophrenia.		although data came from baseline assessment of participants later involved in an investigation of Narrative Enhancement and Cognitive Therapy	centre who met DSM-IV criteria for a SSD - No medication changes (1 month) - No hospitalisations (1 month) - No substance dependence (chart review)	symptom subscales with Bell et al. (1994) factor structure		- Difficulties in Emotion Regulation Scale	No other directly relevant analyses undertaken.

Table 1.30: Summary of records for the USA sample 8 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
Bonfils (2017), USA (Thesis)	Examines whether emotion regulation, metacognition and personal distress	Cross-sectional	None	Outpatients from local community health centres, aged 18 or older, fluent in English, and able to provide informed consent who met	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A – interested in the total score for the	- Derntl Paradigm - IRI - Difficulties in Emotion Regulation Scale	No significant correlation between total metacognition and PANSS-NS. Negative

	predict empathic performance in people with schizophrenia.			DSM 5th edition (DSM-5) criteria for schizophrenia or a SSD		purposes of analyses		symptom scores didn't significantly alter non-significant relationship between metacognition and cognitive empathy.
Bonfils et al. (2019), USA (Journal article)	Examined whether metacognition and personal distress levels related to performance on cognitive and affective empathy tasks, and whether metacognition moderated the relationship between personal distress and empathy in people with schizophrenia	Cross-sectional study	None reported	Fluent English-speaking community mental health centre patients aged 18 or over, with capacity to consent meeting DSM-5 criteria for schizophrenia or schizoaffective disorder	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- Derntl Paradigm - IPII - IRI	PANSS-NS significantly correlated with SR and total metacognition, no other significant correlations identified. MAS-A Total score and all subscales significantly correlated with each other.

	or schizoaffective disorder.							

Table 1.31: Summary or records from the USA sample 9 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Luther et al. (2020), USA (Journal article)	Examined whether metacognition, clinician insight or neurocognition moderated the relationship between self-reported and clinician-rated motivation measures, in people with a SSD	Cross-sectional study	None for this study but data was obtained from baseline assessments of those participating in a randomised pilot trail of a text- message intervention targeting motivation	Outpatients from a community mental health centre, meeting DSM-5 criteria for schizophrenia or schizoaffective disorder. - Receiving services from a community mental health centre - having a text-messaged enabled mobile phone - No medication changes (past month) - No hospitalisations (past month)	PANSS – analysed insight and judgement item	MAS-A – interested in the MAS-A total score for the purposes of this study	- IPII - QLS - MAP-SR - Brief Neurocognitive Assessment	No measure of motivation was significantly associated with total metacognition. MAS-A moderated the relationship between clinician-rated and self-reported motivation measures.

				- 4th grade reading level (Graded Word List) - moderate motivation deficits (Clinical Assessment Interview for Negative Symptoms score ≥ 2 on at least one item from motivation component of interview)				

Table 2.1: Summary of records from the Overlapping participants sample 1 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
MacBeth et al. (2016), Scotland (Journal article; see also conference abstract,	Examines relationship between components of metacognition and negative symptoms and	Secondary data analysis of a cross-sectional cohort study	None	Individuals in the first 12 months of FEP treatment - First presentation to clinical services with psychotic symptoms meeting DSM-IV criteria for an affective or non-	PANSS – used van der Gaag et al. (2006) factor structure in analysis	MAS-R – Decentration is not analysed as a subscale in this model but is an item under	- AAI - DUP - Service Engagement Scale - PAS	Significant correlation between MAS-R individual items for understanding ones' own mind (excluding

MacBeth et al., 2013b)	help seeking within treatment in an FEP sample			affective psychotic disorder with capacity to consent - Positive symptoms of sufficient severity and/or distress to require antipsychotic medication - No acute positive delusions - No substance misuse, head injury or organic disorder as primary cause of psychotic symptoms		Understanding Others' Minds. Mastery not analysed in this study. Derived from AAI narratives.		differentiation items), understanding others' minds items, and decentration – no other significant correlations.

Table 2.2: Summary of records from the Overlapping participants 2 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Buck et al. (2014), USA (Journal article; see also	Examines relationships between anhedonia,	Cross-sectional	None delivered as part of this research, although data	Outpatients meeting DSM-IV criteria for schizophrenia or schizoaffective disorder.	PANSS: analysed positive and negative subscales with	Interested in the total MAS-A score only	- IPII - QOL - BLERT - WCST	Groups clustered by anhedonia/ depression profiles

conference abstract, Buck et al., 2013)	depression, metacognition and social cognition in people with schizophrenia		came from assessment of participants involved in a larger survey of the effects of cognitive remediation on work outcome	- No medication changes (1 month) - No hospitalisations (1 month) - No active substance dependence	Bell et al. (1994) factor structure, plus one component that measures depressive symptoms			significantly different on PANSS-NS, and low depression/high anhedonia group had poorest MAS-A total, Decentration and Mastery scores after controlling for positive and negative symptoms. Anhedonia significantly correlated with individual negative symptom scores (passive withdrawal, emotional withdrawal, blunted affect, poor rapport, disturbance of

								volition, and pre-occupation) and no significant relationship between anhedonia and lack of spontaneity or motor retardation. No significant difference on individual NS scores across anhedonia/ depression groupings apart from preoccupation and disturbance of volition items.
Lolley (2012), USA (Thesis)	Examines relationship between metacognitive	Cross-sectional	None delivered as part of this research, although data	Outpatients from a community mental health centre or a VA Medical Centre meeting DSM-IV	PANSS – only used general psychopathology in analyses	MAS-A – only interested in total metacognition	- IPII - Shedler-Westen Assessment Procedure-200	No directly relevant analyses undertaken

	capacities and symptom severity and personality syndromes in patients diagnosed with schizophrenia or schizoaffective disorder.		obtained from participants who took part in a previous study that examined the effects of cognitive therapy on patient outcomes in individuals diagnosed with schizophrenia	criteria for schizophrenia or schizoaffective disorder - No history of mental retardation - No history of active substance dependence		score for the purposes of this study		
Lysaker et al. (2014d), USA (Journal article)	Examines the relationship between affect recognition and mental state decoding, mental state reasoning, and metacognition for individuals with schizophrenia and examines	Cross-sectional	None	Outpatients from a local VA Medical Centre or a community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder. - No medication changes (30 days) - No housing changes (30 days)	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- BLERT - Eyes Test - Hinting Test - IPII - WCST	Metacognition and negative symptoms made significant contributions to ability to predict emotion recognition scores in a stepwise multiple regression

	performance in comparison to a control group. Study controls for flexibility of abstract thought, positive and negative symptoms and emotion recognition.			- No hospitalisations (30 days) - No active substance dependence - No chart diagnosis of mental retardation				
Lysaker et al. (2014e), USA (Journal article)	Explored whether metacognitive deficits were predictive of group membership for individuals with schizophrenia versus persons with Human Immunodeficiency Virus (HIV), controlling for social cognition	Cross-sectional	None delivered as part of this research, data obtained from baseline assessments of individuals with schizophrenia participating in a series of studies of the effects of cognitive	Outpatients meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No medication changes (30 days) - No housing changes (30 days) - No hospitalisations (30 days) - No active substance dependence - No chart diagnosis of mental retardation - No diagnosis of HIVþ	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- IPII - BLERT	No directly relevant analyses undertaken

			therapy on outcome					
Ringer et al. (2013), USA (Conference abstract)	To examine whether metacognition and social cognition measures could distinguish participants with schizophrenia from participants with no psychiatric illness and HIV/Acquired Immunodeficiency Syndrome (AIDS)	Cross-sectional	None	Individuals with a diagnosis of schizophrenia or schizoaffective disorder	PANSS – analysed with Bell et al. (1994) factor structure (personal communication)	MAS-A	- BLERT - Hinting Task	No directly relevant analyses undertaken
Snethen et al. (2014), USA (Journal article)	Examines relationship between positive, negative and disorganised symptoms of SSDs, flexibility of abstract thought, and metacognitive	Cross-sectional	None	Outpatients aged 18 and above from a Veteran's Administration Hospital and a local public hospital meeting DSM-IV criteria for a SSD - No mental retardation - No active substance dependence	PANSS – analysed positive, negative and disorganisation scales with Bell et al. (1994) factor structure	MAS-A	- IPII - WCST - accelerometer - sex - age - height - weight	No significant correlations between MAS-A subscales and PANSS-NS. Significant correlations between SR UOM, and Mastery

	capacity to physical activity and sedentary behaviour in people with schizophrenia							subscales, and UOM and Decentration, Decentration not significantly correlated with SR and Mastery, and UOM not significantly correlated with Mastery. SR and Mastery significantly related to sedentary behaviour, not other significant relationships between MAS-A total and subscale scores, and PANSS-NS and sedentary behaviour or moderate to

								vigorous physical activity.
Vohs et al. (2016), USA (Journal article)	Examines relationship between gamma activity and components of metacognition in people with schizophrenia	Cross-sectional	Data obtained from participants who were recruited for studies examining clinical neurocognition and metacognitive processing in schizophrenia	Outpatients aged 18-65 years meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No history of electroconvulsive therapy - No history of neurological illness - No current alcohol or drug dependence (DSM-IV criteria) - No hearing impairments (audiometry) - Estimated verbal IQ > 70 - No alcohol use in 24 hours prior to testing	PANSS – analysed positive, negative and disorganised subscales with Bell et al. (1994)	MAS-A	- IPII - EEG	No directly relevant analyses undertaken

Table 2.3: Summary of records from the Overlapping participants 3 dataset

Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative**

								Symptoms and MAS-A
Vohs and Lysaker (2014), USA (Journal article)	Explored relationship between mastery and intrinsic motivation over time in individuals with prolonged schizophrenia	Repeated measures design	Data obtained from participants undertaking an ongoing trial evaluating the effects of cognitive therapy versus supportive intervention on vocational outcomes	Outpatients from a VA Medical Centre or local mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No medication changes (30 days) - No housing changes (30 days) - No substance dependence - No mental retardation	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A - Mastery: classified participants into three categories	- QLS - IPII	No significant differences on PANSS-NS for participants grouped by levels of low, intermediate and high mastery. Mastery significantly correlated with intrinsic motivation over time, and there were significant differences across mastery groups on intrinsic motivation at all timepoints.

Table 2.4: Summary of records from the Overlapping participants 4 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Luther et al. (2016b), USA (Journal article)	Examined whether relationship between metacognition and functioning mediated by intrinsic motivation, controlling for neurocognitive impairments, demographics, psychiatric symptoms and social cognition in people with schizophrenia	Cross-sectional	None	Outpatients aged 18 or above from a VA Medical Centre or community mental health centre meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No hospitalisations (past month) - No signs of organic brain disease (chart review/SCID) - No developmental disability (chart review/SCID)	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A – only total score analysed	- IPII - QLS - WCST - BLERT	Higher metacognition predicted higher levels of intrinsic motivation and intrinsic motivation mediated the relationship between metacognition and functional status, even when controlling for age, education, symptoms, executive

								functioning and social cognition.

Table 2.5: Summary of records from the Overlapping participants sample 5 dataset

Record details	Research aims	Design	Intervention	Schizophrenia Target Group Characteristics	Negative Symptom Measures and Adaptations	Metacognition Measures and Adaptations	Other Measures	Summary of relevant findings regarding Negative Symptoms and MAS-A
Gagen et al. (2019), USA (Journal article)	Examined levels of metacognition across individuals with schizophrenia with different social functioning and positive and negative symptom profiles and the relationship between social functioning and metacognition independent of	Cross-sectional study	Individuals were participants in studies of the effects of psychosocial rehabilitation	Adults receiving outpatient mental health care from a VA medical centre or community mental health centre meeting DSM-IV-TR criteria for schizophrenia or schizoaffective disorder. - No hospitalisations (30 days) - No changes in housing (30 days) - No medication changes (30 days)	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- IPII - QLS	PANSS-NS significantly negatively correlated with MAS-A total score. When grouped on symptom and functioning profile group with profound negative symptoms performed significantly poorer on

	symptoms in people with schizophrenia.							metacognition than those with diffuse symptoms and positive symptoms.
Lysaker et al. (2017), Indiana and New Jersey, New York, USA (conference abstract)	To explore any differences in metacognitive capacity between groups with schizophrenia in central Indiana and an urban area of New Jersey, and the relationship between metacognition and negative symptoms, and insight.	Cross-sectional	None reported	Adults with a SSD in a post-acute phase of illness	PANSS	MAS-A	None specified	Significant relationship between UOM and total metacognition and PANSS-NS – no other significant relationships reported
Lysaker et al. (2019), Indianapolis, Indiana and	Examines association between metacognition and	Cross-sectional	Data was collected prior to participant randomisation	Outpatients from a VA Medical Centre, a community mental health centre, an outpatient	PANSS – analysed with Bell et al. (1994) factor structure	MAS-A	- IPII	Significant differences between groups on insight and

Newark and Piscataway, New Jersey, USA (Journal article)	insight in relation to positive and negative symptom profiles in adults with schizophrenia		into a trial of psychosocial rehabilitation	clinic, meeting DSM-IV criteria for schizophrenia or schizoaffective disorder - No hospitalisations (30 days) - No medication changes (30 days) - No housing changes (30 days) - No participants previously involved in cluster analysis run by this group	(excluded insight item from cognitive component in analysis as this was used as a standalone item to measure insight)			symptom profiles on metacognition were retained when controlling for PANSS where the group on high negative symptoms and impaired insight had poorer mastery

Table 2.6: Summary of records from the Overlapping participants sample 6

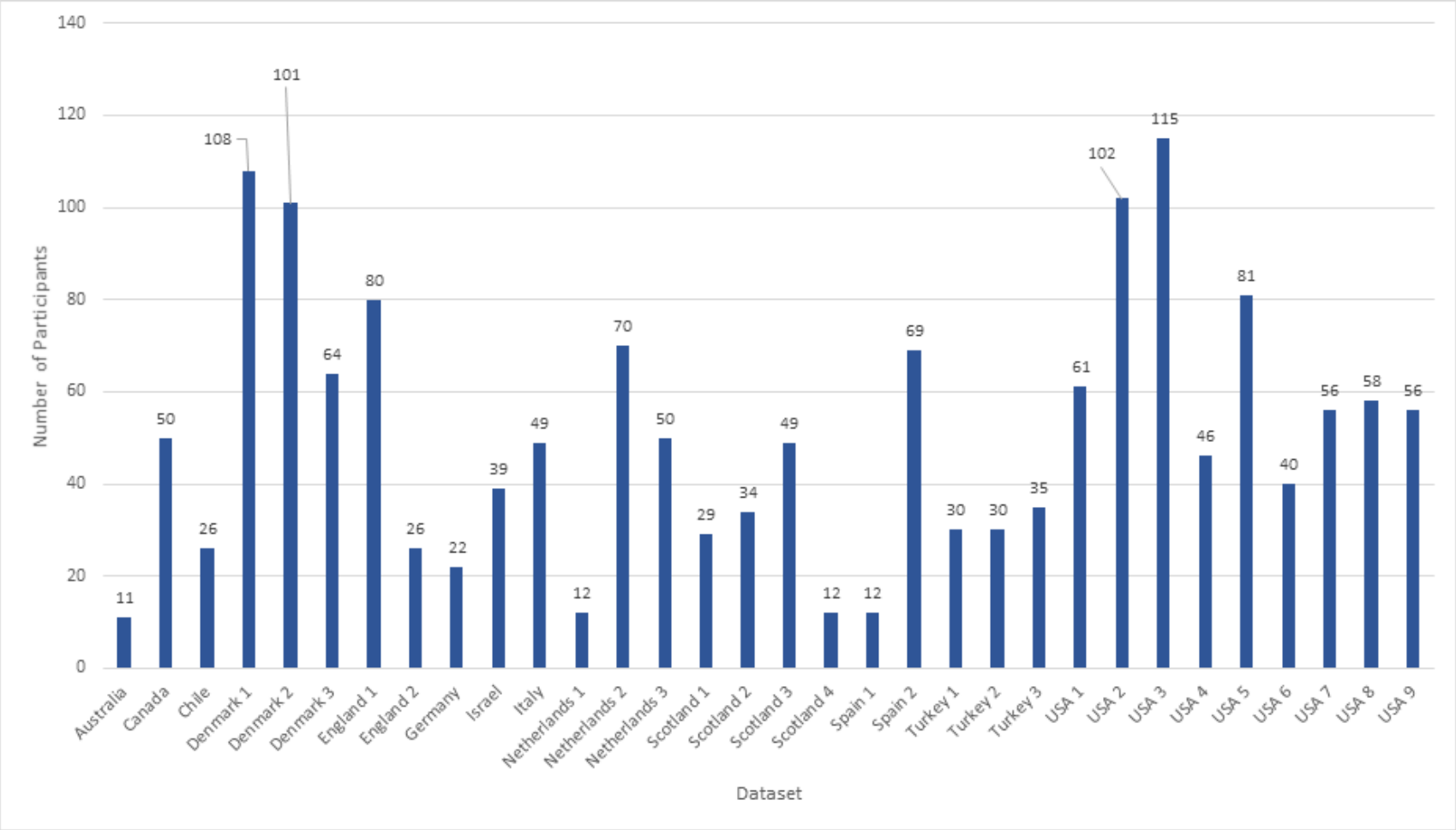
Record details	**Research aims**	**Design**	**Intervention**	**Schizophrenia Target Group Characteristics**	**Negative Symptom Measures and Adaptations**	**Metacognition Measures and Adaptations**	**Other Measures**	**Summary of relevant findings regarding Negative Symptoms and MAS-A**
Wright et al. (2020b), Sussex, England (Journal article)	Examined whether metacognition, intellectual aptitude and	Cross-sectional design	None as part of this research however participants	English speaking EI service patients with a ICD-10 diagnosis of FEP (code F29), aged 18-40 years old	PANSS – analysed with Bell et al. (1994) factor structure	MAI – interested in the total composite score (composed of	- WAIS 2nd Edition - TUS - UPSA	No directly relevant analyses undertaken

	functional capacity predicted engagement in work and number of hours in work in individuals with FEP		did form part of other non-interventional research	- No primary diagnosis of substance abuse disorder - No organic neurological impairment - Used EI service for at least 3 months before beginning of study		averages of each subscale total score) for this study		

AAI: Adult Attachment Interview; **BAI:** Beck Anxiety Inventory; **BCIS:** Beck Cognitive Insight Scale; **BDI:** Beck Depression Inventory; **BLERT:** Bell-Lysaker Emotion Recognition Task; **BPD:** Borderline Personality Disorder; **BPRS:** Brief Psychiatric Rating Scale; **CECAQ:** Childhood Experience of Care and Abuse Questionnaire; **CGI:** Clinical Global Impression; **CPT-II:** Conners' Continuous Performance Test II; **CTQ:** Childhood Trauma Questionnaire; **DKEFS:** Delis-Kaplan Executive Function System; **DUP**: Duration of Untreated Psychosis; **EEG:** Electro-encephalogram; **EI:** Early Intervention; **FEP:** First Episode Psychosis; **GAF:** Global Assessment of Functioning scale; **HVLT:** Hopkins Verbal Learning Test; **ICD:** International Classification of Diseases; **IPII:** Indiana Psychiatric Illness Interview; **IQ:** Intelligence Quotient; **IRI:** Interpersonal Reactivity Index; **ISMIS:** Internalised Stigma of Mental Illness Scale; **MAI:** Metacognition Assessment Interview; **MANSA:** Manchester Short Assessment of Quality of Life; **MAS-A:** Metacognition Assessment Scale – Adapted; **MAS-R:** Metacognition Assessment Scale – Revised; **MATRICS:** Measurement and Treatment Research to Improve Cognition in Schizophrenia; **MCCB:** MATRICS Consensus Cognitive Battery; **MERIT:** MEtacognitive Reflection and Insight Therapy; **MOSST:** Metacognition-Oriented Social Skills Training; **MSCEIT:** Mayor-Salovey-Caruso Emotional Intelligence Test; **NICR:** Narrative Interview for Compassion and Recovery; **PANSS(-NS):** Positive and Negative Syndrome Scale – Negative Subscale; **PAS:** Premorbid Adjustment Scale; **PCL-R:** Hare Psychopathy Checklist – Revised; **PSP:** Personal and Social Performance Scale; **QOL:** Quality of Life scale; **RAS:** Recovery Assessment Scale; **RSES:** Rosenberg Self-Esteem Scale; **SAT-MC:** Social Attributions Test – Multiple Choice; **SCID:** Structured Clinical Interview for DSM; **SCORS:** Social Cognition and Object Relations Scale; **SDM:** Self-Defining Memories; **SR:** Self-Reflectivity; **SSD:** Schizophrenia Spectrum Disorder; **SST:** Social Skills Training; **SUMD:** Scale to Assess Unawareness of Mental Illness; **TMT:** Trail Making Task; **TUS:** Time Use Survey; **UOM:** Understanding Others' Minds; **UPSA:** UCSD Performance-based Skills Assessment; **VA:** Veterans' Affairs; **WAIS:** Wechsler Adult Intelligence Scale; **WCST:** Wisconsin Card Sorting Test; **WMS:** Wechsler Memory Scale

Appendix 3: Sample size across systematic review datasets

Maximum number of participants reported studies included in systematic review, by dataset:



Appendix 4: Direct comparisons between negative symptoms and metacognition in systematic review

Correlations between negative symptoms and subdomains of metacognition

NS cluster	Self-Reflectivity	Understanding Others' Minds	Decentration	Mastery	Total	Studies
PANSS-NS Total	NoS	NoS	NoS	NoS	NoS	Bröcker et al. (2017)
	NoS	S	NoS	S	S	Lysaker et al. (2018b)
	S	S	NoS	S	S	Vohs et al. (2014)
	S	NoS	NoS	S	S	(Minor & Lysaker, 2014)
	S	S	S	S	S	Trauelsen et al. (2016); Trauelsen et al. (2019)
	NoS	S	NoS	NoS	S	van Kleef et al. (2015)
	S	S	NoS	NoS	S	Bonfils et al. (2019)
	NoS	NoS			NoS	Abu-Akel and Bo (2013)
	NoS	NoS		NoS	NoS	Abu-Akel et al. (2015); Lysaker et al. (2010a)
				NoS		Lysaker et al. (2010b)
					NoS	Bonfils (2017)
					S	Lysaker et al. (2013b); Gagen et al. (2019)
	S					Fridberg et al. (2010); Bonfils et al. (2018)
			S		S	Breustedt (2017)
					S (baseline and 6 mo)	Hamm et al. (2012)
	S		NoS			Lysaker et al. (2007)
		S			S	Lysaker et al. (2017)
	NoS (6 & 12 months)	S (6 months) NoS (12 months)	S (6 & 12 months)	S (6 months) NoS (12 months)		McLeod et al. (2014)
	NoS	NoS	NoS	NoS		Snethen et al. (2014); Tas et al. (2014)
	S	S				Rabin et al. (2014)
		S		S	S	Vohs et al. (2016)
N1	NoS	NoS	S	NoS	NoS	Bo et al. (2015)
	NoS	NoS		NoS		Lysaker et al. (2005)
N4	NoS	NoS	S	NoS	NoS	Bo et al. (2015)
N2	S	S		S		Lysaker et al. (2005)
G13	NoS	NoS		NoS		
BPRS withdrawal/ retardation scale	S	S	NoS	NoS	S	Popolo et al. (2017)
Intrinsic Motivation				S		Vohs and Lysaker (2014)
					NoS	Luther et al. (2020)
Total Significant*	**11**	**11**	**7**	**9**	**14**	
Total Non-significant*	**14**	**12**	**10**	**14**	**8**	

* Excluding conference abstracts (highlighted blue). **NoS:** Non-significant, **S:** Significant

Appendix 5: Comparisons between negative symptoms, metacognition and other constructs in systematic review

Of the 29 analyses investigating the impact of negative symptoms on the relationship between metacognition and other variables, 10 were of the same reports already giving correlation coefficients for the direct relationship between metacognition and negative symptoms. Table 1 below shows the covariates which were investigated in relation to metacognition or subtypes of metacognition, and whether these relationships were/were not influenced by levels of negative symptoms. Two additional analysis also found metacognition to play a significant role in negative symptom experiences, and these were the only analyses where metacognition acted as the covariate. One (Luther et al., 2020) found metacognition to be a significant moderator of self-rated versus clinician ratings of motivation, and another (Gagen et al., 2019) showed that metacognition was significantly different for individuals when they were grouped by symptoms and functioning levels where lower metacognition was likely for the group with negative symptoms. Another analysis not included in the table is a network analysis (with one of the largest sample sizes reported across studies) where negative symptoms is a significant node in a network linking metacognition, neurocognition and social cognition (Hasson-Ohayon et al., 2018a).

Similar to direct comparisons between metacognition and negative symptoms, covariate analyses results are mixed. Specifically social cognition (Lysaker et al., 2010a; 2010b; James et al., 2016; 2018; Hasson-Ohayon et al., 2018a), empathy (Bonfils, 2017; Lysaker et al., 2018b) and insight (Lysaker et al., 2013c; 2019), all show different relationships across studies. Again it is likely that the clustering of participants and variation in measures used may have contributed to these mixed results. One cluster analyses (Kukla et al., 2013), showed that negative symptoms were not a significant variable when added to a model examining the relationship between metacognitive profiles and recovery. Similarly, studies comparing metacognition at the subdomain level showed mixed results, even within the same study (Buck et al., 2014; Leonhardt et al., 2015; Lysaker et al., 2018b).

Table 1: Significance of negative symptoms as a covariate in the relationship between metacognition and additional variables

Variable	Self-reflectivity	Understanding Others' Minds	Decentration	Mastery	Total MAS	Study Assessing
Self-esteem and hopelessness	S					Bonfils et al. (2016)
Anhedonia/ depression profiles	NoS	NoS	S	S	S	Buck et al. (2014)
Childhood Trauma	S		S	S		Leonhardt et al. (2015)
					S	Trauelsen et al. (2019)
Emotion recognition					S	Lysaker et al. (2014d)
Empathy (IRI)				S	S	Lysaker et al. (2018b)
Insight				S		Lysaker et al. (2019)
Quality of Life		S				Rabin et al. (2014)
Positive Symptoms					S	Trauelsen et al. (2016)
Empathy					NoS	Bonfils (2017)
Functioning					NoS	Davies et al. (2017); de Jong et al. (2018c); Lysaker et al. (2011h)
Work satisfaction					NoS	de Jong et al. (2014)
Appraisal of work behaviour	NoS					Lysaker et al. (2011c)
Role of mPFC					NoS	Francis et al. (2017)
Social Cognition/ Functioning				NoS		Lysaker et al. (2010b)
					NoS	Lysaker et al. (2010a); James et al. (2016); James et al. (2018)
Caregiver mastery, negative caregiver experiences and critical comments					NoS	Jansen et al. (2017)
Discrete metacognition (BCIS/TOM)					NoS	Lysaker et al. (2012)
Depression/ Insight profiles					NoS	Lysaker et al. (2013c)
Stigma resistance					NoS	Nabors et al. (2014)
Neurocognition and cannabis use					NoS	Schnakenberg et al. (2016)
Sedentary behaviour/ MVPA					NoS	Snethen et al. (2014)

IRI: Interpersonal Reactivity Index; **mPFC:** Medial Pre-Frontal Cortex; **BCIS:** Beck Cognitive Insight Scale; **TOM:** Theory of Mind; **MVPA:** Moderate to Vigorous Physical Activity

Appendix 6: Author contact form

"Investigating the relationship between specific negative symptoms and metacognitive functioning: a systematic review and IPD meta-analysis"
Data items of interest

Dear [insert co-author name here],

Following on from our initial correspondence, I have outlined below the **anonymised** information that we would like to request from agreed collaborators.

- **Participant ID**
- **Date** of data collection
- **MAS-A** scores (total scores for each domain):

Self-reflectivity (S)
Awareness of the mind of the other (O)
Decentration (D)
Mastery (M)

Alternatively, the total MAS-A score for each participant, or alternatively, group subgroup scores or group MAS-A total scores as available.

- **All individual PANSS or BRPS data** (or other symptom measure data as appropriate). The most crucial and minimum PANSS items that I require for analyses are:

CODE	NEGATIVE SYMPTOM SUBTYPE
N1	Blunted affect
N2	Emotional withdrawal
N3	Poor rapport
N4	Passive/apathetic social withdrawal
N5	Difficulty in abstract thinking
N6	Lack of spontaneity and flow of conversation
N7	Stereotyped thinking
G5	Mannerisms and posturing
G7	Motor retardation
G8	Uncooperativeness
G11	Poor attention
G13	Disturbance of volition
G14	Poor impulse control
G15	Preoccupation
G16	Active social avoidance
P2(-)	Conceptual disorganisation

Where individual PANSS data is not available, total **PANSS negative subscale scores** (at individual level if possible, and at group level if not available) would be helpful. Additionally, this would require definition of which factor-analysis items have been identified as part of the negative symptoms subscale (e.g. Bell et al., (1994), or van der Gaag et al., (2006).

- **Demographic information** and, where possible, the criteria for these where applicable (i.e. all possible categories, date ranges/age ranges etc). The following variables are of particular interest:

Age

Gender (or sex, please specify)

Race

Diagnoses (including any physical conditions, learning disabilities, or neurological conditions recorded)

Education

Adverse childhood experiences

Socioeconomic status

- **Secondary outcome measures** (including the name, and total scores for each participant) that investigate:

Neurocognition (e.g. measures of attention/memory/executive functioning)

Discrete metacognitive abilities (Including measures of theory of mind/mentalisation or attributional biases)

Functioning (including overall/social/domestic and personal role functioning)

Wellbeing (including quality of life/satisfaction measures)

Social support (please specify whether based on individual perceptions or objective levels of support)

- Additionally, we are looking to investigate **reasons for any missing data**. An aggregate statement about the nature and reasons for missing data across studies will be made in the final report.

Appendix 7: Data Management Plan (DMP)

Outline

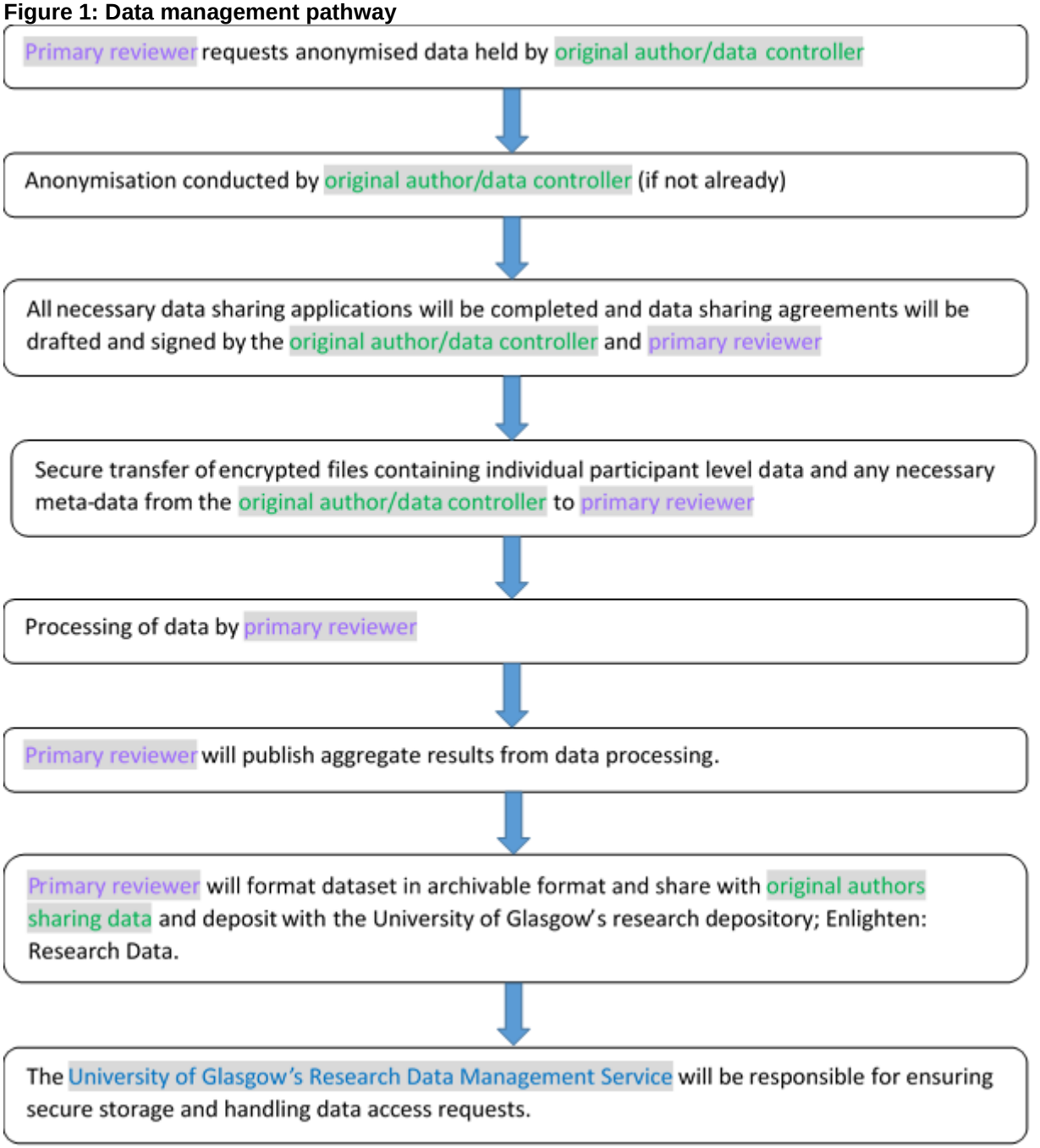
This data management plan will aim to identify the legitimate interest the researchers have in processing individual participant level data from previous research studies which have measured synthetic metacognition and negative symptoms for a systematic review and IPDMA. This plan will outline the processing required to investigate the strength of the relationship between metacognitive abilities and negative symptoms and which components of metacognition are related to which specific negative symptom experiences. Reasons for the use of the specific data identified will be outlined and the benefits and risks to both the individual participants and society will be outlined as well as strategies for minimising risk. The need for this DMP was identified because the data being transferred in order to conduct the IPD meta-analysis is sensitive.

Data processing procedure

Individual participant data from studies which are selected as part of the systematic review will be collected from the original authors or any data repositories where this data is held. In order to do this, authors or the current data controllers will be informed of the purposes of the request for the data and asked for consent for the primary reviewer to receive access to the data requested. Data will then, if possible, be anonymised if this has not already taken place and transferred to the primary reviewer in an encrypted format. The primary reviewer will process participant data in relation to demographic characteristics and scores on two measures; the positive and negative syndrome scale (Kay et al., 1987); and the Metacognition Assessment Scale – Adapted (Lysaker et al., 2005). When the processing of the IPD level data is complete the primary reviewer will report the results of the research in an aggregate format, and the dataset will be stored in the University of Glasgow's research repository; Enlighten: Research Data and will also be securely shared with original authors participating in the review through encrypted secure file transfer. After the sharing of the anonymised data the Research Data Management Service at the University of Glasgow will be responsible for the secure storage and retention of the data in line with organisational and data protection policies.

A flow diagram of the data management pathway is provided in Figure 1:

Figure 1: Data management pathway



Outline of data to be collected and scope of project

The personal sensitive data being processed will include the dataset for any study including participants MAS-A scores and any items that have been included in any iteration of the negative symptoms factor after the initial development of the PANSS. Demographic data requested for each participant will include the following:

- Age
- Gender
- Race
- Diagnoses
- Education
- Adverse Childhood Experiences
- Socioeconomic Status
- Neurocognitive measures; including attention, memory and executive function
- Measures of discrete metacognitive abilities; including theory of mind, mentalisation or attributional bias measures.
- Measures of functioning; including social, domestic and personal role functioning or overall functioning
- Wellbeing measures; including those which measure quality of life and satisfaction
- And any measures of perceived or objectively identified levels of social support.

Additionally, potentially sensitive meta-data will also be collected including the geographical location from which participants were recruited. This data will include individual participant level data from all participants included in the identified studies which will be analysed in the systematic review, meaning this could affect a large population of research study participants worldwide. The researcher is requesting the entire dataset as it is likely that at the time of the original data collection the data might not be structured as required for this research project (Medical Research Council, 2017). However, the curation of data extraneous to this project might also serve to support further research questions through the provision of the shared anonymised dataset. For the purposes of research and in line with the University of Glasgow's data retention

requirements, this data will be securely retained for a period of at least ten years. The primary reviewer may also seek to collect any additional data that is provided by published studies regarding components of metacognition and negative symptoms after the initial systematic review is complete and prior to the submission of the primary reviewer's thesis for the purposes of her PhD.

Consideration of participants whose data will be collected

The primary reviewer will request anonymised data. Therefore, it is considered unlikely that this data, only previously reported publicly in aggregate form, could be linked to specific individuals by any member of the public. Equally for any motivated intruder to identify the participants whose data is used, they would need to gain access to any anonymisation codes provided by the original authors which will be held independently from the systematic review dataset and typically at the same institution as the where the original dataset is held. This means it is very unlikely for a motivated intruder to successfully link the data to any available information. Furthermore, other individuals who may wish to gain access to the data, including professionals who have conducted research which will be included in the systematic review, are likely to have collaborated on the review meaning that they will have access to the final shared data set upon the completion of the review, and equally would not hold data making re-identification possible unless they were already involved within the study. These potentially motivated intruders are also held by professional ethical boundaries and codes of practise that would prohibit the wilful subversion of confidentiality procedures.

The primary reviewer will be expected to have no prior knowledge of the participants involved in the original research, to decrease the likelihood that the primary reviewer will have any conflict of interest in conducting the review. As the request for data will be posited to the data controllers, the participants will have little knowledge or control over the use of this data. However, at the point of original data collection, participants will have been made aware of research anonymisation procedures and the time frame within which they can rescind data, meaning they will be aware of these factors prior to their consent is given to take part in the research. Participants will also be made aware of the purpose of the research when they consent to the study. For these reasons, and that the aim of this review should be in-keeping with the aims of the original research,

participants should have some expectation of their data being used in this way. The importance of protecting data from vulnerable participants is acknowledged to be paramount in this study, and steps will be taken to ensure that the high-standard security procedures adopted as part of the original research are maintained. The processing of this data is not novel and as such will aim to follow adhere to the IPD meta-analysis guidelines around the processing of this data (Riley et al., 2010b).

Given that the sensitivity of this data has been highlighted, the potential harms and benefits of this processing must be highlighted. The purpose of this research is to contribute to knowledge around the relationship between components of synthetic metacognition and specific negative symptoms, as well as the impact of this relationship on functioning. The processing of this data will not support any medical decisions made in regards to the care and treatment of the individuals whose data is provided, nor is its re-use anticipated to incur any substantial damage or distress to any of the subjects. Furthermore, the anonymisation of this dataset will aim to protect participants from any discrimination or disadvantage that may occur from their identification as a participant in this research. Therefore, it is suggested that the data processing incurred for the purposes of this review is unlikely to cause any harm to the participants.

Furthermore, the re-use of participant's anonymised data is in-keeping with the purposes of the original data collection (i.e. research) and will also further the conclusions made by the research that the participants originally were included in. The publication of this aggregated data will therefore provide substantial benefit to society in terms of provided increased understanding to an underserved area of knowledge which can eventually contribute to improvements in policy and treatments for people who experience negative symptoms. Additionally, the re-use of data has economic benefits and is supported by leading research institutes including the MRC as it is less burdensome on potential participants and can reduce the costs associated with data collection(Medical Research Council, 2017). This suggests that overall, the benefits of the data collection outweigh the harms that may be caused to the participants, and that this is the most appropriate way of collecting these data.

Consultation

It has been deemed that given that participants will have already given consent for their data to be used for the purposes of research and is anonymised, it would not be possible or proportionate to contact individuals whose data is collected to seek their views in regards to the data processing. Additionally, even if participant's contact data was still available, further contact after participants have completed the original research may be contrary to the expectations participants had after originally participating in the research. The use of these participants data without their full explicit consent for the purposes of this review, given that the data is anonymised and for research purposes, is however deemed to be within DPA guidelines (Information Comissioner's Office, 2018).

Given that the use of these data will require the collaboration of the original authors or data controllers from the original research studies that are to be included in the review, the opinions of these individuals will be consulted prior to the processing of these data. If this data management plan infringes with the expectations of the original authors or data controllers for sharing these data, then, where possible, this data management plan will be amended to ensure that the processing of these data adheres to the requirements of the original authors or data controller. However, given that this data management plan is currently recognised to adhere to European and American guidance on the use of these data for these purposes, it is likely that this data management plan will meet these standards. Original authors who completed the original collection of these data will be acknowledged on the report, and those who contribute to the final draft of the report will additionally be included as an author on the systematic review publication. Additionally, if those who provide the data or the copyright holder of the data is different to the original authors, these parties will also be acknowledged in the final report.

Necessity and proportionality

As previously outlined, the primary reviewer is suggested to have a lawful basis for processing according the ICO guide to the GDPR (Information Comissioner's Office, 2018). Particularly, given that this data is anonymised, this information can(Information Comissioner's Office, 2018) be processed legally under section 7

of the data protection act which states that data protection principles shall not apply to data rendered anonymous in such a way that the data subject is no longer identifiable. The primary reviewer is also identified to have legitimate interests in processing the data given that this processing is necessary and proportionate for achieving the purposes of research while aiming to protect the fundamental rights and interests of the data subject. To ensure that this legal basis is maintained, the primary reviewer will take several steps to ensure that the aim of this review and the proportionality of the data processing is maintained.

Specifically, the primary reviewer will aim to prevent a creep in the function for which the data processing serves by pre-specifying the aims of the review in the systematic review protocol. Secondly, the researcher will take steps to ensure that data is anonymised sufficiently, including the minimisation of potentially sensitive data (such as identifying specific ages of individuals by asking for age in years only). Furthermore, the provision of this data management plan will serve to minimise the use of data in a way that would be incompatible with the purposes for which the data was originally collected, and to ensure that individuals' privacy rights and opportunities to have control over the use of their data are supported as far as possible. Within the constraints of the anonymisation processes adopted however, it will not be possible for individuals to access their data from this dataset or for the retraction or rectification of individual participant level data. However, if the primary reviewer receives notifications of such from the original authors then these changes can be made. The data management plan will also serve to ensure transparency and accountability in the processing of data which will incentivise data processors to comply with both data protection and ethical guidelines. Finally, these aims will also be upheld through the secure transfer of these data in an encrypted format to ensure that international transfers are safe and compliant with these aims and all necessary regulations.

Assessment of identified risks

A table of the identified risks and their assessment is reported in Table 1 in line with DPIA guidelines:

Table 1: Risk assessment of data processing

Source of risk and potential impact on individuals/compliance/organisation.	Likelihood of harm	Severity of Harm	Overall
	Remote possible or probable	Minimal significant or severe	Low medium or high
The re-identification of participants included in the original datasets through a breach of intended data access would pose a risk to individuals privacy rights, could risk discrimination of the person, reputational damage to the primary reviewer and the University of Glasgow, and a loss of public confidence in the ability of trusted professionals to securely hold sensitive personal data.	Remote	Serious harm	Low risk
A breach of security in the transfer of the data would risk the original authors or data controllers being unable to fulfil their data protection obligations and could risk reputational damage to the primary reviewer, the University of Glasgow, the original authors or data controllers and the institutions they represent. This would also risk a loss of public confidence in the ability of trusted professionals to securely hold sensitive personal data.	Remote	Serious Harm	Low Risk
Sharing of the final dataset that was incompatible with data protection guidance around the use of anonymised participant data could risk reputational damage to the primary reviewer, the University of Glasgow, the original authors or data controllers and the institutions they represent, and any individuals who might subsequently use the dataset. This would also risk a loss of public confidence in the ability of trusted professionals to uphold the rights of individual data subjects	Remote	Serious Harm	Low Risk

Measures to further reduce identified risks

Although the risks identified in relation to the processing of this data are low, there are additional steps that the primary reviewer can also take to reduce the risks identified, listed in Table 2.

Table 2: Risk mitigation options

Risk	Options to reduce or eliminate risk	Effect on risk	Residual risk	Measure approved
		Eliminated reduced or accepted	Low medium or high	Yes/No
The re-identification of participants	1. Data will be securely stored in accordance with the University of Glasgow's data security procedures (Information Security Advisory Group (University of Glasgow), 2010). 2. Sensitive data will be minimised where possible, both in the dataset and the aggregate published information (i.e. age numbers reported as year only etc). 3. Anonymised participant data will be requested and the participant identification numbers used for the purposes of the data processing will be anonymised upon receipt of the full data set by allocating random numbers to each individual participant after duplication of participant information is identified. 4. In the reporting of the data in aggregate form data which might link participants to small sample sizes (i.e. geographical location) will be suppressed.	Reduced	Low	Yes
Breach of security in transfer of data	1. Data will be sent via a recognised method of acceptable security standards. 2. Data that is sent will be encrypted to prevent access of data by a motivated intruder.	Reduced	Low	Yes

Incompatible subsequent use of dataset	1. Meta-data will be provided explaining the nature of the dataset and the intention for its use. 2. Governance around the sharing of the information will be implemented to ensure that data is appropriately used and original authors who are given access to the data set will be asked to complete a data sharing agreement.	Reduced	Low	Yes

Responsibility for outcomes

The primary reviewer will have principal responsibility for ensuring that all data management processes are adhered to during the transfer and processing of data. The primary reviewer will also be responsible for the reporting of any breaches in data management procedures and any effects of this. The primary reviewer will also be responsible for ensuring the appropriate deposit of data to the University of Glasgow's research repository after the completion of the review and that appropriate data sharing agreements are created prior to the sharing of any data with the original authors. As these tasks form part of the primary reviewer's PhD studies the supervisors of the primary reviewer will also be responsible for ensuring that the primary reviewer fulfils these obligations.

Appendix 8: Ethical review confirmation

Nicola McGuire (PGR)

From: MVLS Ethics Admin <mvls-ethics-admin@glasgow.ac.uk>
Sent: 23 February 2018 09:59
To: Nicola McGuire; MVLS Ethics Admin
Subject: RE: Query - Ethics application required

Hi Nicola

I checked with the committee and they confirm you do not need ethical approval to request these data

Regards
Neil

Neil Allan
MVLS Ethics Administrator

Direct line: 0141 330 5206

Institute of Infection, Immunity & Inflammation
College of Medical, Veterinary & Life Sciences
Glasgow Biomedical Research Centre
Room 314, Sir Graeme Davies Building
University of Glasgow
120 University Place
Glasgow G12 8TA
The University of Glasgow, charity number SC004401

From: Nicola McGuire
Sent: 21 February 2018 15:16
To: MVLS Ethics Admin <mvls-ethics-admin@glasgow.ac.uk>
Subject: Query - Ethics application required

Hello,

I am planning on conducting a systematic review with a meta-analysis of independent participant level data. This will be investigating the relationship between subtypes of metacognition and subtypes of negative symptoms.

This will involve me contacting researchers who have previously reported on the relationships between metacognition and negative symptoms, and requesting individual participant level data for individual scores on two validated psychometric measures. I will be requesting fully anonymised data and will not hold any participant identifiable information. However, the transfer of this data will be subject to the regulations of those who share the data with me and I suspect will need to be securely stored.

1

I wonder whether you could advise me as to whether I should submit an ethics application in this instance?

I am not entirely sure that I have sent my enquiry to the right place - if not, would you please re-direct me?

Kind Regards,

Nicola

Nicola McGuire

PhD Student

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Appendix 9: Statistical Analysis Plan (SAP) for Individual Participant Data Meta-Analysis

Protocol title

Investigating the relationship between specific negative symptoms and metacognitive functioning: protocol for a systematic review and meta-analysis

Date of SAP: 24/09/2020 **Protocol Version:** PROSPERO registration

Roles and Responsibility: Nicola McGuire is responsible for the development and implementation of the statistical analyses plan.

SAP revision history

1. PANSS data was not rescaled from 0-6 as opposed to 1-7 as recommended by Leucht et al. (2010) because it is not relevant to the type of statistical analyses being conducted.
2. Given that there were only two studies using the BRPS, the BPRS meta-analyses could not be conducted and is therefore removed from the section on Independent variables.
3. MAS-R data was not included in any meta-analyses because it was identified to be scored too different from the MAS-A data for it to be meaningfully compared.
4. Education was most commonly recorded as a continuous variable which justified using education as a continuous variable in the IPDMA.
5. There were inadequate numbers of participants in certain covariate categories to be able to meaningfully conduct some covariate analyses (i.e. in-patient/outpatient analyses, studies not using a codebook or independent assessor for the MAS-A). Some information was not available across enough of the datasets (primary diagnoses, adverse childhood experiences, socioeconomic status), and some covariates would have created too many categories to be feasibly included in the meta-analyses (race/ethnicity).

6. The section on data with uncertain parameters is removed as once the data collection process was complete there was no further need of this item.
7. Given advice from statistical expert, and considering the number of variables to be included in the analyses, a one stage model was deemed to be less appropriate for the IPDMA and a two-stage model was adopted instead. This analyses was also extended *post-hoc* to include comparisons with other summed scores of negative symptoms as this seemed important for understanding results.
8. The extension of primary analyses – controlling for covariates section on reporting has also been amended to reflect reporting of only those covariates included upon analyses – other variables are described in the full data extraction sheet and available on request.
9. The extension of primary analyses – relationship with secondary outcomes was also removed because there was not sufficient data on secondary outcomes to include them meaningfully in data analyses.
10. The section on extension of primary analyses has been extended. Extensions of primary analyses were added in accordance with data handling procedures in SAP (V1, 03/07/2018); to control for duration of illness by excluding FEP samples, and disorganisation symptoms respectively. The justification for the first sensitivity analyses is that upon completion of data collection it became apparent that the majority of samples were of individuals who had experienced multiple episodes of psychosis. Research suggests that some outcomes for people with MEP are different to those with FEP (Sauve et al., 2018) which may affect results. Therefore, only MEP samples were included in a sensitivity analyses to determine whether findings retained significance. For the second sensitivity analyses, researchers suggest that many of the items contributing to the original factor analyses of the PANSS negative symptom subscale actually consists of several items which more accurately represent cognitive disorganisation (Blanchard & Cohen, 2006). Therefore, when IPDMA findings showed that the PANSS Negative symptoms subscale had the largest beta coefficients of all negative symptom subscale comparisons it seemed appropriate to test

whether cognitive disorganisation items may have contributed to this finding by testing their relationship with metacognition separately.

11. The final extension to the primary analyses rests on the finding that 82.4% of individuals in the total dataset had negative symptom scores of 29 or less (with the rest of the data being attributed to a possible score of between 30-49). This suggests that there may be clusters of participants who differ significantly on negative symptoms and metacognition. This is important to determine who these results might apply to, therefore we sought to test for this through cluster analysis.

Background and Rationale

This research is interested in understanding the relationships between the following variables:

- Metacognition – ability to integrate information to create complex narratives about the self and others and utilise this in formulating ways of coping with social challenges and psychological distress.
- Negative symptoms - an absence or reduction of typical experiences, including anhedonia, amotivation, asociality, alogia and affective blunting

Individual Participant Level Data is more appropriate for the exploration of these relationships because many current aggregate data reports fail to differentiate negative symptoms, and do not always analyse the relationship between negative symptoms and individual components of metacognition. Additionally, previous analyses in some research studies might have lost valuable data by stratifying individuals by categories that group a range of scores for components of metacognition, as opposed to treating these scores as an interval variable (i.e. Lysaker et al., 2011f). This might have eliminated meaningful variation in the data that would be important for such specific analyses. An IPD-MA would eliminate some of these limitations of previous research, and would allow an increased sample size which could increase the power to conduct these analyses. In addition, an opportunity to investigate the original dataset for each study can help highlight inconsistencies in reporting, and provides the ability to standardise the analyses conducted and the introduction of relevant covariates (Riley et al., 2010b).

This systematic review and meta-analyses will compare Individual Participant Data (IPD) from studies which have previously investigated levels of synthetic metacognition and negative symptoms. This review will address the following specific research questions:

1. Using IPD, what are the relationships between different components of metacognition and specific negative symptoms for individuals previously included in studies investigating these variables?
2. Given relationships demonstrated by IPD, what participant and study level specific factors may be responsible for the variance in results across studies?
3. How do data analyses of individual participant level data exploring metacognition and negative symptoms compare with those analyses of previously aggregated and potentially overlapping datasets in terms of ability to draw conclusions, and risk of bias?

This statistical analyses plan will consider the rationale for the statistical methods which will be employed in order to address these questions. For the purposes of elucidating the statistical models that will be required to investigate these relationships, these research questions have here been rephrased in terms of their null and alternative hypotheses:

Hypotheses

1.1. Broadly speaking, the reviewer hypothesises that levels of different synthetic metacognitive abilities will be predictive of levels of specific negative symptoms. However, given limited existing published evidence, no predictions are made in regards to which specific metacognitive abilities are predictive of which specific negative symptoms. It is predicted that significant relationships will be inversely (negatively) correlated i.e. as a component of metacognition increases, a specific negative symptom will decrease. The reviewer will also qualify the sample for whom these relationships are observed.

1.2. The null hypothesis is that there will be no evidence demonstrating a predictive relationships between any distinct metacognitive capacities and any specific negative symptoms.

2.1. The reviewer hypothesises the inclusion of covariates additionall explain some of the variance in the statistically significant models from the primary analysis, although the reviewer makes no predictions about which covariates may be explanatory.
2.2. The null hypothesis is that there will be no evidence indicating that the covariates identified explain any of the variance in these models.

3.1. It is not anticipated that the results from aggregate reports will be comparable to those of IPDMA. It is predicted that the IPDMA will confer significant advantages over aggregate data analysis. No predictions are made as to whether there will be inconssitencies between IPD data and aggregate data, or between studies which did and did not provide IPD.
3.2. The null hypothesis is that there will be no evidence of any differences between IPD and aggregate data analyses.

The primary analyses is encapsulated by the first hypotheses which refers to the main aim of the systematic review and meta-analysis, which is to understand the relationship between components of metacognition and specific negative symptoms in the context of previous studies.

Data handling

Variables for inclusion in the primary analyses

For each individual in each study, where reported, the following data will be included in the analyses:

Independent variables

Measures of components of metacognition as defined by the MAS-A (Lysaker et al., 2005). This scale differentiates components of synthetic metacognition which have been found to be related to experiences of negative symptoms (McLeod et al., 2014). Typically, the adapted version of the scale performs similarly to the original scale, by eliciting participant views about their mental health through an interview measure (usually the Indiana Psychiatric Illness Interview; Lysaker et al., 2002b), but deviates in its structuring of metacognitive components. In comparison to the

original version, the MAS-A only allows subsequently ordered metacognitive capacities to be measured if an individual presents sufficient capability to engage with the preceding category. Therefore, in this research, all metacognitive scores will be recorded in increments of 0.5 or 1 for up to all four components, and any scores for components of metacognition recorded which are higher than the preceding category will be questioned with the original authors. The ordering of these categories is as follows:

Self-reflectivity (reported as a numerical value 0-9)

Awareness of the mind of the other (reported as a numerical value between 0-9)

Decentration (reported as a numerical value between 0-3)

Mastery (reported as a numerical value between 0-9)

Dependant variables

Measures of the PANSS items (Kay et al., 1987) which have previously been recorded as being indicative of negative symptoms will be recorded which are the following items:

- Blunted affect
- Emotional withdrawal
- Poor rapport
- Passive/apathetic social withdrawal
- Difficulty in abstract thinking
- Lack of spontaneity and flow of conversation
- Mannerisms and posturing
- Motor retardation
- Uncooperativeness
- Poor attention
- Disturbance of volition
- Poor impulse control
- Pre-occupation
- Active social avoidance

Covariates

Gender – which will be treated as a dichotomous variable with the categories male and female

Education variables will be included as a continuous variable based on years of education.

It is unclear whether the other covariates of interest; age, adverse childhood experiences, and socioeconomic status, will be recorded as categorical or interval data, and indeed this might differ across studies, therefore the parameters for these variables will be defined after data collection is completed.

Data characteristics

Data cleaning

Of the studies which are determined to meet the inclusion criteria, values for individual participants will be checked to ensure that they are plausible within the parameters described above. Individual data values for a specific variable for a participant which are regarded as implausible will be removed from the dataset and this data value will be regarded as missing. The number of data values removed and reasons for removing these will be recorded as part of the descriptive analyses of study and participant characteristics.

Where values for a variable are undefined and likely to differ across studies, data may be transformed. The proportion of data available and their various levels of detail with which they are described in each study will be reported, and factors leading to any transformations and the potential loss of information in the meta-analyses as a result of transformations will be discussed.

Composite data transformations

Decisions to transform data will be based on whether a transformation will allow 80% of the IPD to be included in the meta-analysis at the smallest level of detail possible. For variables that can be computed via single data items, or composite scoring, this might mean the loss of composite information. For example, if 80% of studies reported data on Adverse Childhood Experiences (ACEs), but of those

studies, 30% used a composite measure, scoring items around frequency and severity of ACEs, and the remaining 70% of studies reported only frequency information, then available ACE data would be most likely transformed to reflect only frequency data (assuming individual items on the ACE measure are provided).

Where only total composite scores are given, and in this example, frequency data could not be obtained, this would result in the loss of this information (potentially meaning this information could not be included in a meta-analysis). In cases where composite scores will be used as a measure of an item, it was decided that there would be limited benefits from imputing individual data items to create a composite score that could be included in a meta-analysis, therefore only complete case composite score data will be included.

Categorical data transformations

For categorical data, decisions to transform for the purposes of meta-analysis will be based on whether re-categorisation allows meaningful standardisation, and the inclusion of IPD from more studies. For example, when some studies report a less informative category than other categories available in other studies (i.e. in the case of ethnicities reporting the category Asian, versus the categories Indian and Chinese), and this information is an important covariate, then it is likely that the category across studies will be transformed to the most all-encompassing category (i.e. Asian) to ensure data from all possible studies is included. Where only a small proportion of available categorical data for a specific item is less informative (i.e. if only 5% of the studies reporting ethnicity used a broader category such as Asian), then a sensitivity analyses will be conducted to determine whether exclusion of this data and use of the more informative categories might affect results (provided that this still allows 80% of IPD to be meta-analysed). However, to save computational complexity, it is decided that in addition to this rationale for potential transformations, any transformations for a categorical variable to then be included in a meta-analysis must be limited to no more than 3 categories. In cases where more detailed categories are provided, this may mean that the reviewer must transform these categories to a more superficial category and some information will be lost.

Continuous variable transformation

As an extension of this logic, data when coded continuously, can also feasibly be categorised i.e. age can be categorised as different age ranges. This may be appropriate where combining continuous data with categorical data allows a greater availability of IPD so as to reach an appropriate level for inclusion in meta-analysis (i.e. 80%). In this case however, continuous data will be preferable to categorical data, as this will significantly reduce computational complexity, and categorisation significantly reduces statistical power. Again in the instance that any continuous variable was to be categorised, no more than 3 categories can be created, to save computational complexity.

Assessing the extent of missing data

Missing data is a common issue for IPD meta-analyses of health-related information (Debray et al., 2015). A risk of bias may arise when conducting complete case analyses if the missing data is not missing at random, and is in fact related to study variables. Therefore, it is important that the reviewer attempts to identify the reasons for missing data insofar as possible. The reviewer will therefore quantify the missing data for all independent and dependant variables and any patterns or differences between individuals who have missing and non-missing data will be reported. Specifically, the probability of data-missingness will be estimated based on other potentially relevant variables to determine if these predict the reporting of these data. These analyses will aim to reflect the important variables which will be included in the statistical model for the primary analyses. Unfortunately, there is no way of computing whether missing data is missing at random or not at random, however the reviewer will discuss potential systematic predictors of missing data in relation to previous evidence where data is identified to be missing and related to other observed values. This is in line with approaches outlined by The Fibrinogen Studies Collaboration (2009).

Accounting for missing data

When attempting to account for missing data by multiple imputation, researchers need to ensure that their modelling accounts for both the clustering of participants by each study and the heterogeneity in missing values. Researchers are still unclear as to which method of multiple imputation is best

to impute missing data, as well as the ways in which these should be combined across studies. Given that it is expected that there will be relatively little systematically missing data in the data collected for the purposes of this IPD-MA, and given a sufficient sample size, it seems unlikely that selecting only complete cases for this meta-analysis would have a large impact on the observed results. Additionally, researchers (Jolani et al., 2015) have reported that complete case analysis and other methods of within-study imputation often perform with only slightly decreased performance in significantly increased computation time in IPD meta-analysis.

Primary analyses

Statistical model

Meta-analyses were conducted in a two-stage approach using R version 3.5.3 to determine the whether metacognitive domains predicted levels of individual negative symptoms. In an attempt to deal with the computational complexity of the meta-analytic models used, we conducted individual meta-analyses for each specific negative symptom identified in as an independent variable to estimate the predictive value of each subcomponent of the MAS-A (self-reflectivity; understanding others' minds; decentration; and mastery). We used Seemingly Unrelated Regression (SUR), which helps to account for the correlation between these different metacognitive capacities (Zellner, 1962) which is pertinent given previous analyses show that these subcomponents are highly correlated (e.g. Bonfils et al., 2016). The four obtained beta coefficients from each SUR analysis (describing the degree of change in a specific negative symptom given a 1-unit change in each metacognitive domain), were then combined in a multivariate meta-analyses which again attempted to control for the relationship between metacognitive domains, unlike a univariate approach. A random-effects model was used and was estimated using REstricted Maximum Likelihood (REML), to reduce downward bias in between-study variance estimates.

Between-study heterogeneity was quantified by the I^2 statistic and observed using univariate analyses forest plots for each metacognitive subdomain and individual negative symptom. We used two-sided *p* values and 95% CIs of the estimated effect to determine the statistical significance of results and small study effects were assessed using funnel plots and influence of outliers were also checked through visual inspection and influence diagnostic computations. For

any multivariate meta-analyses with significant results, subsequent tests were performed to determine whether age and education affected the results.

Assumptions for conducting regression analyses were checked and several sensitivity analyses were performed including a comparison between SUR outcomes and those which would be observed by multiple regression, and a comparison of univariate versus multivariate meta-analyses. It was anticipated that IPD for individual negative symptoms might not be available in all cases, therefore it was also decided that the total negative symptom scores should also be investigated. PANSS negative symptom subscale scores were compared using the original version of the subscale (PANSS-ONS). The Bell et al. (1994) and van der Gaag et al. (2006) symptom factor structures (PANSS-BNS, and PANSS-VDGNS) were also examined as a *post hoc* sensitivity analyses. As it is also recognised that negative symptoms can be separated into experiential and expressive negative symptoms, and these were therefore also compared using the Harvey et al. (2017) factor structure.

Extension of primary analyses – sensitivity analyses

Statistical model

The Bell et al. (1994) cognitive subscale, and the van der Gaag et al. (2006) disorganisation subscale (which both measure cognitive disorganisation) were assessed as a sensitivity to analyses to determine whether they had a similar relationship with metacognition as PANSS-ONS showed. Finally, as a large proportion of the studies included multiple episode psychosis groups, a sensitivity analyses was conducted to determine whether including either of these populations alone in the meta-analyses affected results.

Carrying forward the final model from the primary analyses (to save computational complexity) the researcher will then consider the impact of potential covariates on the experience of negative symptoms. Individual covariates and their interaction terms will be added and then removed, and significant covariates and their interactions will be reported and added into the final statistical model. Again, stagewise linear regression will be used to determine the significant factors to be retained in the final model. Dummy variable coding will be used for categorical variables to be able to include them in the regression model as demonstrated in (Miller & Haden, 2006).

Extension of primary analyses – cluster analyses

Statistical model

Data suggests that over 82.4% of the overall sample had negative symptom scores below 30 (out of a possible 49). This raises the question as to whether there are groups of participants who have significantly different levels of negative symptoms and metacognitive abilities. This can be addressed through k-means cluster analyses. It is not appropriate to perform k-means clustering analyses on participants who are already clustered by different datasets, therefore participants will be not be grouped by dataset when conducting k-means clustering. We will use distance and gap statistic metrics to determine the best potential fit of clusters before conducting the cluster analyses with the most likely best fit. Clusters will then be attributed to the individual data in their original dataset, allowing us to conduct an ANOVA to examine statistical differences in metacognition and negative symptoms across clusters, while accounting for the differences between datasets, as in the other meta-analyses conducted. Like the other analyses we will also conduct a random effects meta-analyses using REML.

Reporting

In addition to an extension of the models reported in primary analyses section, we will report descriptive statistics of covariates of interest. These will be reported prior to the primary analysis to allow readers to contextualise the analysis results within the representativeness of the sample. These descriptive statistics will include:

Mean age (and age range)

Gender (proportion male:female)

Education

Negative symptoms (at summed, subscale and individual item score levels)

Metacognition (at summed and subscale score levels)

Final IPDMA models will be reported in full across the final report and supplementary documents. Where there is too much information to be reported

succinctly (for example the individual regressions involved in sensitivity checks for the primary analyses) and important issues require discussion, examples will be given. Results will be reported in line with with Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA; Moher et al., 2009) guidelines and PRISMA guidelines for IPD (PRISMA-IPD; Stewart et al., 2015).

Appendix 10: IPDMA data processing

Breakdown of imputation errors

It is worth specifying that errors in imputation are based upon the data we receive from co-authors. This means where summed scores have not been provided we cannot estimate whether the summed scores computed for the relevant published reports were accurate. We also cannot determine any errors in imputation at item level (other than ratings given which are higher than the possible maximum score, however this did not occur). Of the datasets where we did receive item level and summed score data for the PANSS and MAS-A data seemed to be imputed accurately. However, there were some errors in the computation of MAS-A total scores (5 participants in the Denmark 1 dataset, 1 participant in the Chile dataset), and the PANSS negative symptom subscales scores (3 participants in the Chile sample, 3 participants in the Italy, sample, and participants in the Germany sample). Additionally, some datasets include PANSS negative symptom total scores where individual item data is not available (USA 7 and Chile sample). All PANSS negative symptom subscale items and MAS-A total scores were re-computed for all datasets and checked to ensure accuracy.

Data completeness

Table 1 below shows a breakdown of data completeness for each dataset including systematically missing data and missing data for individual participants.

Table 1: Data completeness summary

Dataset	No Of Participants Missing	No of systematically missing variables (and names)	No of participants with some data missing (describe)	Sample Size (% with complete data)
Chile	0	0	1 – Positive and Negative Syndrome Scale (PANSS) Passive/Apathetic Social Withdrawal (N4) item and PANSS – Original (O), Bell (B), van der Gaag (VDG), and Experiential (Exper) scale scores 1 – All PANSS and Metacognition Assessment Scale – Adapted (MAS-A) data 1 – All MAS-A data and age 1 – age and education	36 (72.2%)

			3 – all MAS-A data 3 – all PANSS data 1 – all PANSS data and age	
China	0	All individual PANSS items and subscale scores different to the original factor structure	0	90 (100%)
Denmark1	0	Education, PANSS Conceptual Disorganisation (P2), Emotional Withdrawal (N2), Poor Rapport (N3), Difficulty in Abstract Thinking (N5), Stereotyped Thinking (N7), Motor Retardation (G7), Uncooperativeness (G8), Poor Attention (G11), Disturbance of Volition (G13), Poor Impulse Control (G14), Preoccupation (G15), Active Social Avoidance (G16), Tension (G4), Unusual Thought Content (G9), Disorientation (G10), Lack of Judgement and Insight (G12), PANSS-ONS, PANSS-BNS, PANSS-VDGNS, PANSS-Exper, PANSS – Expression subscale (Express), VDGCOG, BELLCOG	0	108 (100%)
Denmark2	0	0	27 – all PANSS and MAS-A data 1 – all PANSS and MAS-A data and education 3 – all PANSS data 1 – N7, PANSS-ONS, and Cognitive Disorganisation scale with Bell (BELLCOG) and van der Gaag (VDGCOG) factor structures 4 – All MAS-A data 1 – N4, PANSS-ONS, PANSS-BNS, PANSS-VDGNS and PANSS-Exper	129 (71.3%)
Germany	0	0	1 – PANSS-BNS, PANSS-VDGNS, PANSS-Express, G7, G12, VDGCOG and BELLCOG 1 – VDGCOG, G15, and PANSS-BNS	22 (90.91%)
Israel	1 (informed of)	G4, G9, G10, G12, VDGCOG, BELLCOG	1 – PANSS data	38 (97.37%)
Italy	0	1 - education	0	26 (100%)
Netherlands1	0	1 – education	1 – PANSS data	70 (98.57%)

Netherlands2	0	1 – education	1 – MAS-A Data	24 (95.8%)
Scotland2	32 (excluded)	1 – education	6 – MAS-A data 2 – PANSS-ONS and N5	32 (75%)
Scotland3		1 – education	17 – no MAS-A data 1 – no PANSS and MAS-A data, no age 2 – no PANSS and MAS-A data 1 – no age 1 – no MAS-A data and no age	47 (53.19%)
Scotland4	0	Gender, education, all individual PANSS items and subscale scores different to PANSS-ONS	5 – MAS-A data 1 – age	12 (50%)
Spain	0	Age, education, individual PANSS items and any negative symptom subscale different from the original negative symptoms factor structure	0	69 (100%)
Turkey 2	0	Individual PANSS items and subscales different from PANSS-ONS	0	35 (100%)
USA2	0	0	1 – G10, MAS-A data 1 – MAS-A data 1 – G11	108 (97.2%)
USA3	0	0	5 – MAS-A data	57 (91.23%)
USA5	0	0	0	36 (100%)
USA6	0	0	0	36 (100%)
USA7	3	0	1 – PANSS-BNS, PANSS-VDGNS, G13 and VDGCOG 2 – PANSS-ONS, PANSS-BNS, PANSS-VDGNS, PANSS-Express and Blunted Affect (N1) item 1 – Mannerisms and Posturing (G5) item, BELLCOG and VDGCOG 1 – Mastery 1 – BELLCOG, G4, G8, P2 and PANSS-VDGNS 16 – MAS-A data 29 – all PANSS data, age, gender, education 1 – VDGCOG, PANSS-BNS, PANSS-VDGNS and G15, 1 – all PANSS and MAS-A data 1 – All PANSS data	181 (70.17%)
USA8	0	1 – education	0	58 (100%)
USA9	0	N1-N4, Lack of Spontaneity and Flow of Conversation (N6), PANSS-ONS, PANSS-BNS, PANSS-VDGNS,	13 –G14 and N5 1 – G4, G11, G5, P2 and N7 items 1 – P2, N7, G5, G11, G4	56 (73.21%)

		PANSS-Exper, PANSS-Express, G7, G13, G15, G10, VDGCOG		

BELLCOG: Bell et al. (1994) Cognitive disorganisation subscale; **G5:** Mannerisms and posturing; **G7:** Motor retardation; **G8:** Uncooperativeness; **G11:** Poor attention; **G13:** Disturbance of volition; **G14:** Poor impulse control; **G15:** Preoccupation; **G16:** Active social avoidance; **MAS-A:** Metacognition Assessment Scale – Adapted; **N1:** Blunted affect; **N2:** Emotional withdrawal; **N3:** Poor rapport; **N4:** Passive/apathetic social withdrawal; **N5:** Difficulty in abstract thinking; **N6:** Lack of spontaneity and flow of conversation; **N7:** Stereotyped thinking; **PANSS-BNS:** Positive and Negative Syndrome Scale (Bell et al., 1994) – Negative Subscale; **PANSS-Exper:** Positive and Negative Syndrome Scale – Experiential Deficits; **PANSS-Express:** Positive and Negative Syndrome Scale – Expressive Deficits**;** **PANSS-ONS:** Positive and Negative Syndrome Scale – Original Negative Subscale; **PANSS-VDGNS:** Positive and Negative Syndrome Scale (Van der Gaag et al., 2006) – Negative Subscale; **VDGCOG:** Van der Gaag et al. (2006) Cognitive disorganisation subscale

Appendix 11: Individual negative symptom meta-analyses

Table 1: IPDMA estimates of relationship between self-reflectivity and individual negative symptoms

Negative Symptom Item	Beta coefficient	CI Upper	CI Lower	P value
Blunted affect (N1)	-0.000	-0.003	0.002	0.742
Emotional withdrawal (N2)	-0.002	-0.007	0.003	0.386
Poor rapport (N3)	-0.004	-0.010	0.003	0.278
Passive/apathetic social withdrawal (N4)	-0.000	-0.002	0.002	0.921
Difficulty in abstract thinking (N5)	-0.001	-0.006	0.004	0.774
Lack of spontaneity and flow of conversation (N6)	-0.005	-0.012	0.002	0.176
Stereotyped thinking (N7)	-0.003	-0.011	0.005	0.470
Mannerisms and posturing (G5)	-0.001	-0.003	0.002	0.670
Motor retardation (G7)	-0.000	-0.003	0.002	0.745
Uncooperativeness (G8)	-0.001	-0.004	0.003	0.721
Poor attention (G11)	-0.000	-0.003	0.003	0.829
Disturbance of volition (G13)	-0.000	-0.003	0.002	0.878
Poor impulse control (G14)	-0.000	-0.002	0.002	0.939
Preoccupation (G15)	-0.000	-0.004	0.004	0.856
Active social avoidance (G16)	-0.000	-0.003	0.002	0.749

Table 2: IPDMA estimates of relationship between understanding others' minds and individual negative symptoms

Negative Symptom Item	Beta coefficient	CI Upper	CI Lower	P value
Blunted affect (N1)	-0.000	-0.004	0.003	0.816
Emotional withdrawal (N2)	-0.005	-0.017	0.006	0.382
Poor rapport (N3)	-0.010	-0.024	0.003	0.131
Passive/apathetic social withdrawal (N4)	-0.000	-0.004	0.003	0.844
Difficulty in abstract thinking (N5)	-0.001	-0.007	0.005	0.715
Lack of spontaneity and flow of conversation (N6)	-0.006	-0.015	0.002	0.164
Stereotyped thinking (N7)	-0.002	-0.009	0.006	0.685
Mannerisms and posturing (G5)	-0.001	-0.006	0.003	0.648
Motor retardation (G7)	-0.001	-0.008	0.006	0.763
Uncooperativeness (G8)	-0.001	-0.006	0.004	0.671
Poor attention (G11)	-0.001	-0.005	0.004	0.736
Disturbance of volition (G13)	-0.002	-0.009	0.005	0.598
Poor impulse control (G14)	-0.000	-0.003	0.003	0.975
Preoccupation (G15)	-0.000	-0.004	0.003	0.837
Active social avoidance (G16)	-0.000	-0.005	0.004	0.855

Table 3: IPDMA estimates of relationship between decentration and individual negative symptoms

Negative Symptom Item	Beta coefficient	CI Upper	CI Lower	P value
Blunted affect (N1)	-0.000	-0.007	0.006	0.886
Emotional withdrawal (N2)	-0.006	-0.020	0.008	0.408
Poor rapport (N3)	-0.010	-0.029	0.009	0.325
Passive/apathetic social withdrawal (N4)	0.000	-0.007	0.007	0.935
Difficulty in abstract thinking (N5)	-0.000	-0.017	0.016	0.971
Lack of spontaneity and flow of conversation (N6)	-0.006	-0.022	0.010	0.459
Stereotyped thinking (N7)	-0.001	-0.009	0.007	0.828
Mannerisms and posturing (G5)	-0.001	-0.009	0.007	0.818
Motor retardation (G7)	-0.000	-0.008	0.008	0.969
Uncooperativeness (G8)	-0.002	-0.010	0.006	0.652
Poor attention (G11)	-0.001	-0.006	0.005	0.807
Disturbance of volition (G13)	-0.002	-0.013	0.009	0.740
Poor impulse control (G14)	-0.000	-0.004	0.004	0.903
Preoccupation (G15)	-0.001	-0.008	0.007	0.887
Active social avoidance (G16)	0.000	-0.009	0.009	0.944

Table 4: IPDMA estimates of relationship between mastery and individual negative symptoms

Negative Symptom Item	Beta coefficient	CI Upper	CI Lower	P value
Blunted affect (N1)	-0.000	-0.003	0.002	0.749
Emotional withdrawal (N2)	-0.003	-0.010	0.003	0.334
Poor rapport (N3)	-0.006	-0.015	0.003	0.179
Passive/apathetic social withdrawal (N4)	-0.000	-0.002	0.002	0.988
Difficulty in abstract thinking (N5)	-0.001	-0.005	0.003	0.693
Lack of spontaneity and flow of conversation (N6)	*-0.007*	*-0.013*	*-0.000*	*0.048*
Stereotyped thinking (N7)	-0.001	-0.005	0.003	0.558
Mannerisms and posturing (G5)	-0.000	-0.003	0.002	0.674
Motor retardation (G7)	-0.000	-0.002	0.001	0.811
Uncooperativeness (G8)	-0.001	-0.005	0.003	0.606
Poor attention (G11)	-0.001	-0.006	0.003	0.525
Disturbance of volition (G13)	-0.000	-0.003	0.002	0.803
Poor impulse control (G14)	-0.000	-0.002	0.002	0.985
Preoccupation (G15)	-0.000	-0.002	0.002	0.779
Active social avoidance (G16)	-0.000	-0.004	0.003	0.787

Table 5: IPDMA estimates of relationship between total metacognition and individual negative symptoms

Negative Symptom Item	Beta coefficient	CI Upper	CI Lower	P value
Blunted affect (N1)	*-0.072*	*-0.102*	*-0.041*	*>0.001*
Emotional withdrawal (N2)	*-0.080*	*-0.101*	*-0.059*	*>0.001*
Poor rapport (N3)	*-0.092*	*-0.116*	*-0.069*	*>0.001*
Passive/apathetic social withdrawal (N4)	*-0.029*	*-0.050*	*-0.009*	*0.005*
Difficulty in abstract thinking (N5)	*-0.075*	*-0.095*	*-0.054*	*>0.001*
Lack of spontaneity and flow of conversation (N6)	*-0.101*	*-0.137*	*-0.064*	*>0.001*
Stereotyped thinking (N7)	*-0.081*	*-0.099*	*-0.063*	*>0.001*
Mannerisms and posturing (G5)	*-0.045*	*-0.062*	*-0.028*	*>0.001*
Motor retardation (G7)	*-0.039*	*-0.056*	*-0.022*	*>0.001*
Uncooperativeness (G8)	*-0.047*	*-0.064*	*-0.030*	*>0.001*
Poor attention (G11)	*-0.051*	*-0.074*	*-0.027*	*>0.001*
Disturbance of volition (G13)	*-0.036*	*-0.062*	*-0.012*	*0.006*
Poor impulse control (G14)	-0.003	-0.022	0.016	0.788
Preoccupation (G15)	*-0.041*	*-0.068*	*-0.014*	*0.003*
Active social avoidance (G16)	-0.013	-0.041	0.015	0.358

Appendix 12: Heterogeneity and publication bias analysis

This section reports the forest and funnel plots for each IPDMA. As there was not available code to provide forest and funnel plot data for the multivariate analyses (where the correlation between MAS-A domains are controlled for), the plots from univariate analyses are reported, however it is worth noting that the beta coefficients may be slightly inflated and the confidence intervals are wider. However, we chose to report given that these give a general impression of the factors which contribute to heterogeneity.

Figure 1: Forrest Plot examining the relationship between self-reflectivity and PANSS-ONS

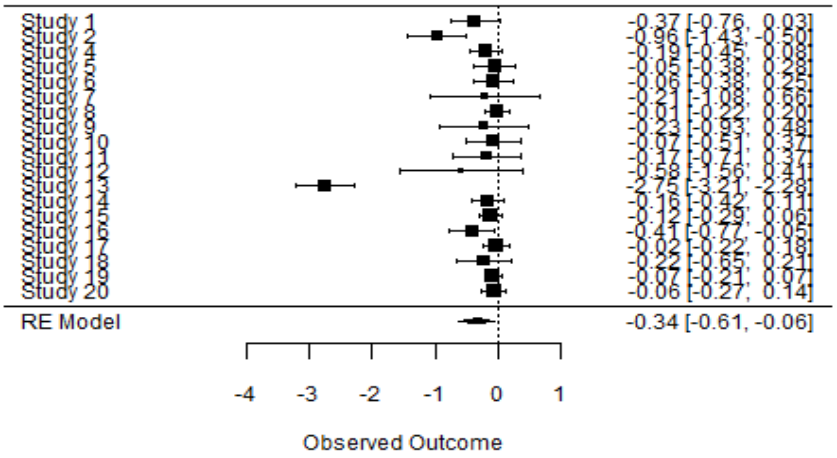


Figure 2: Forrest Plot examining the relationship between understanding others' minds and PANSS-ONS

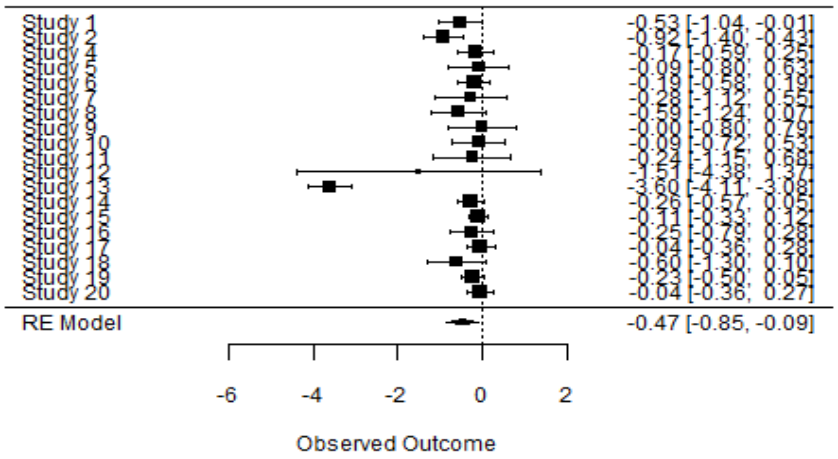


Figure 3: Forrest Plot examining the relationship between decentration and PANSS-ONS

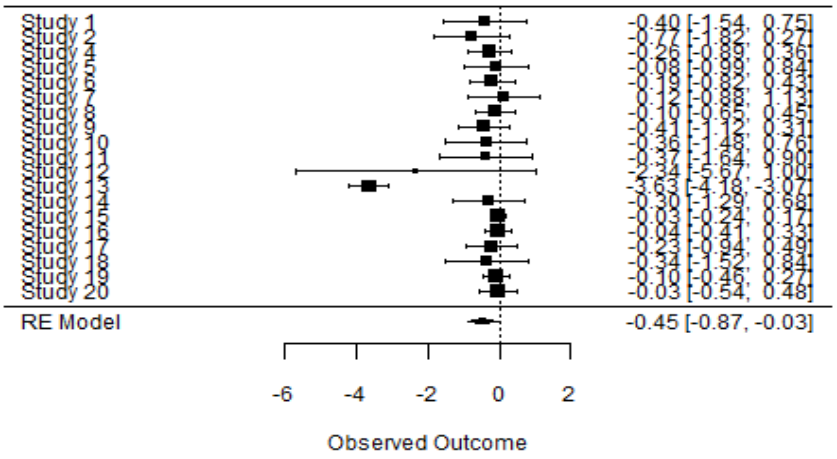


Figure 4: Forrest Plot examining the relationship between mastery and PANSS-ONS

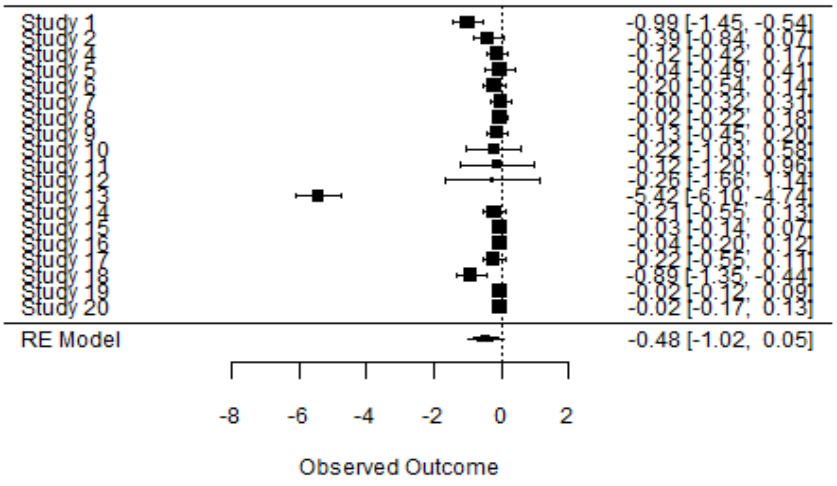


Figure 5: Forrest Plot examining the relationship between total metacognition and PANSS-ONS

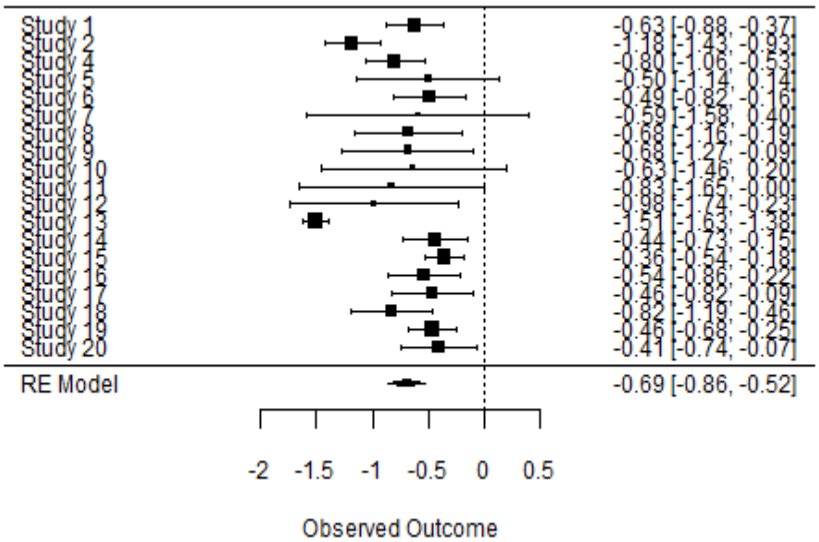
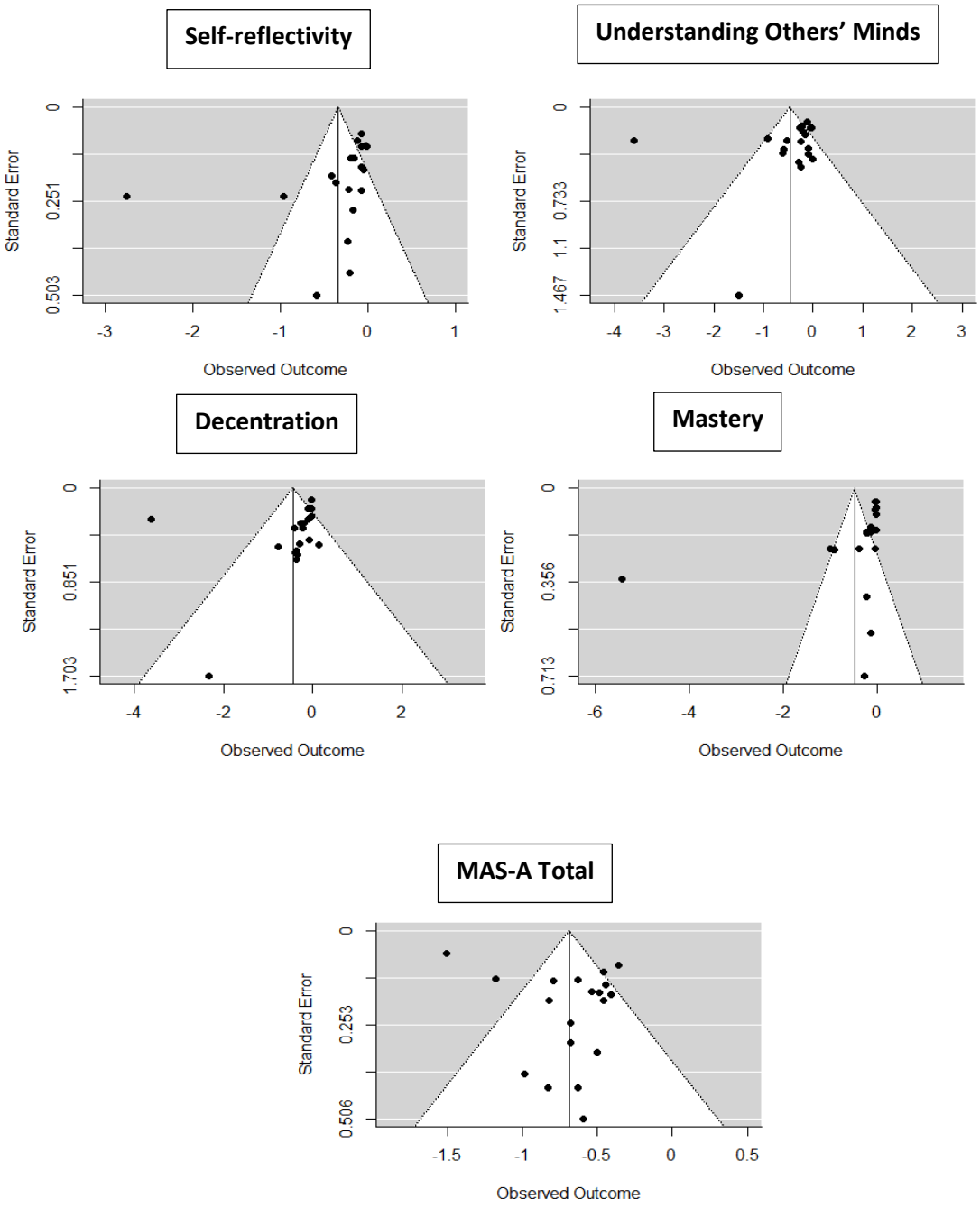


Figure 6: Funnel Plots examining the relationship between MAS-A domains and PANSS-ONS



Appendix 13: Data irregularities

Examples of non-linear data

Key

Figure Label	Variable
VDG	Positive and Negative Syndrome Scale total negative symptoms score with van der Gaag et al. (2006) factor structure
Exper	Experiential Negative Symptoms Subscale
N2	PANSS Emotional Withdrawal item
SMASA	Metacognition Assessment Scale – Adapted (MAS-A) Self-Reflectivity subscale
OMASA	MAS-A Understanding Other's Minds subscale
DMASA	MAS-A Decentration subscale
MMASA	MAS-A Mastery subscale

Figure 1: PANSS-VDGNS and MAS-A Subscale Scatterplots for Denmark 2 Sample

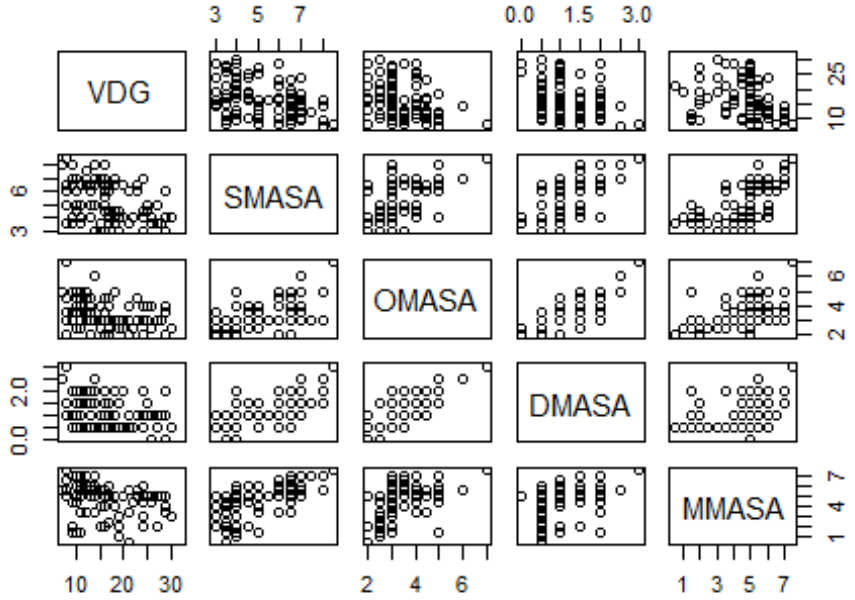


Figure 2: Experiential Negative Symptoms and MAS-A Subscale Scatterplots for Italy Sample

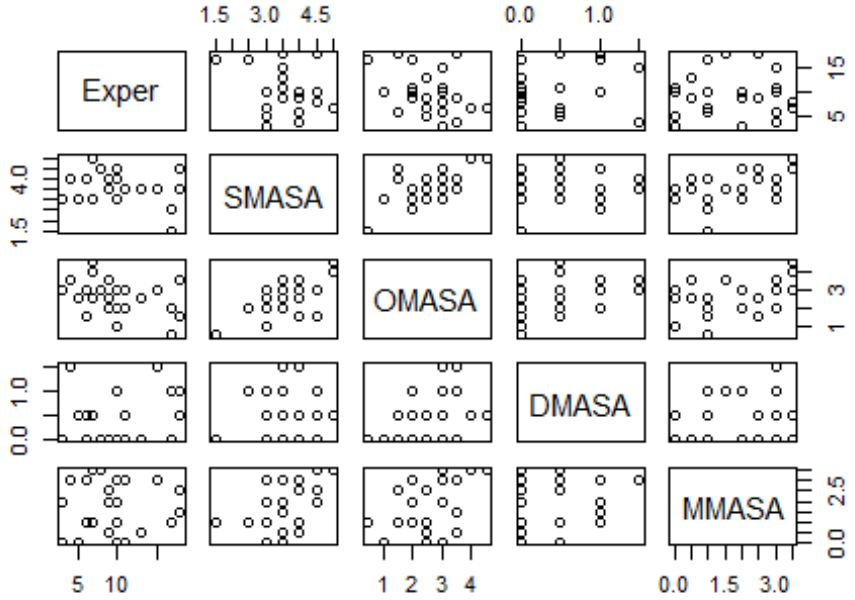
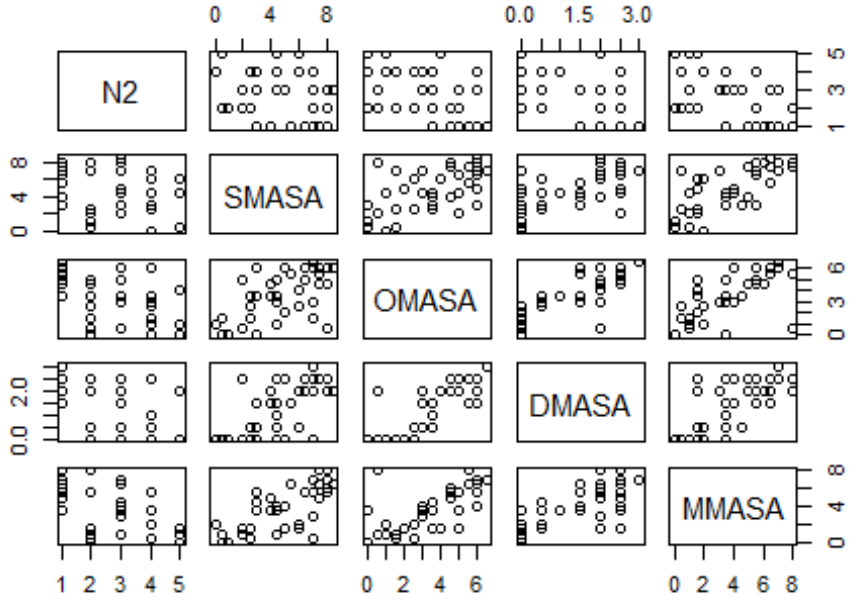


Figure 3: Emotional Withdrawal and MAS-A Subscale Scatterplots for Israel Sample



Examples of right skewed data

Figure 4: Histogram of residuals for PANSS (original factor structure) data from USA 6 sample

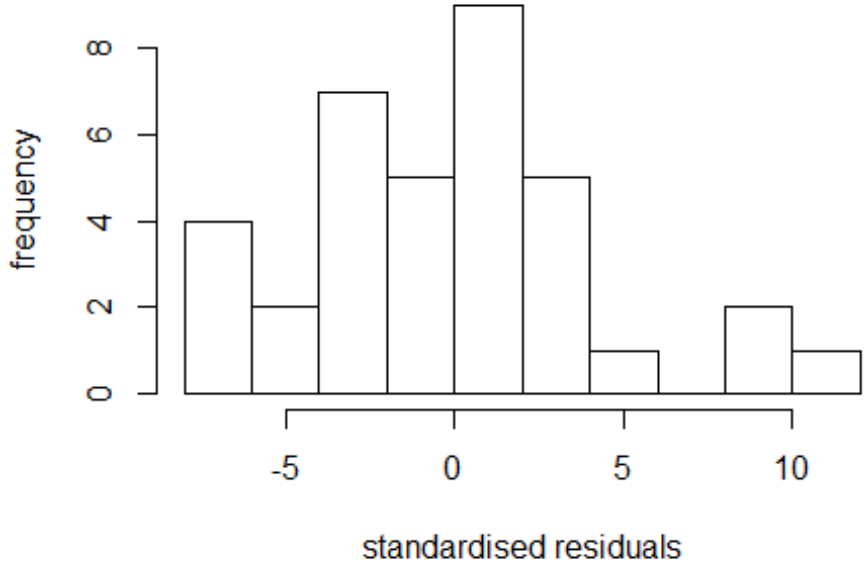


Figure 5: Histogram of residuals for Expressive Negative Symptoms data from Chile data

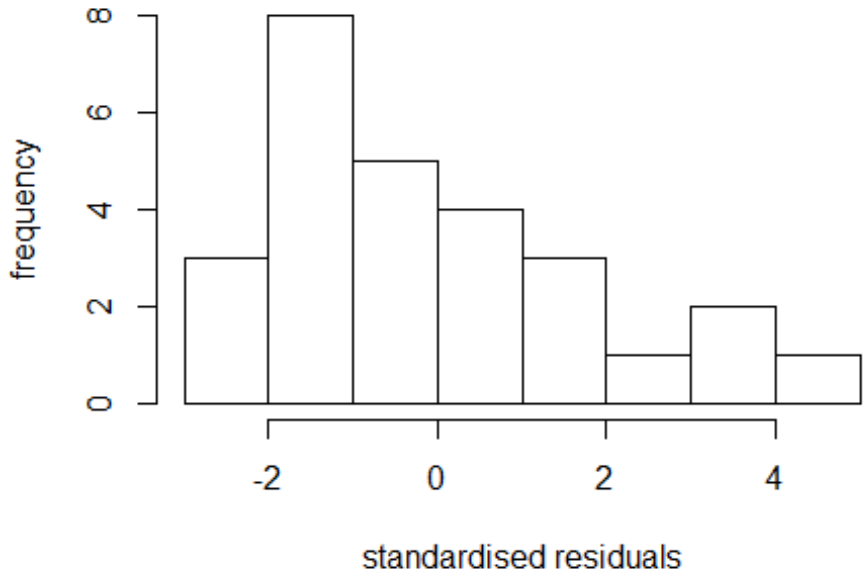
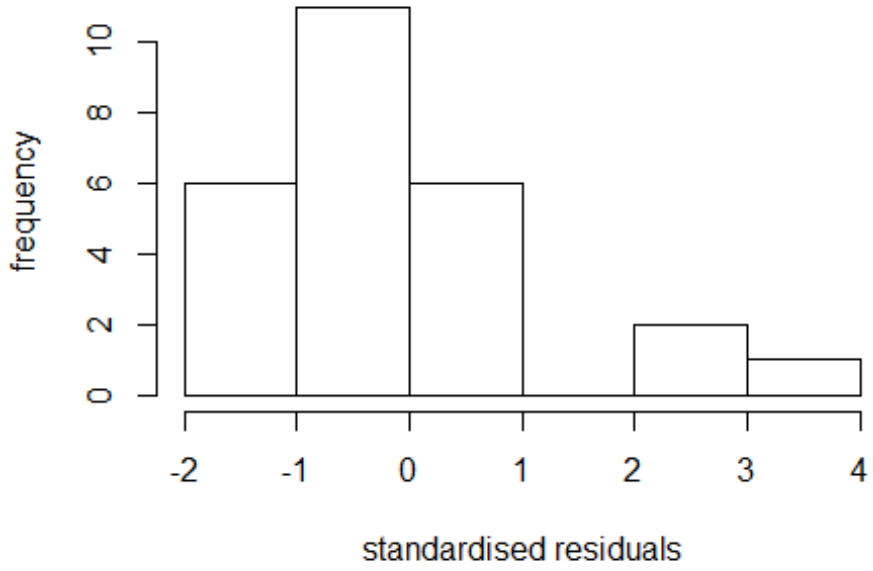


Figure 6: Histogram of residuals for N3 data from Scotland 3 sample



Appendix 14: Cognitive disorganisation models

Table 1: van der Gaag et al. (2006) factor structure

MAS-A component	Beta coefficient	CI upper	CI lower	P value
Self-reflectivity	-0.020	-0.0059	0.019	0.315
Understanding Others' Minds	-0.028	-0.096	0.040	0.423
Decentration	-0.042	-0.133	0.049	0.364
Mastery	*-0.098*	*-0.179*	*-0.017*	*0.018*
Total MAS-A	*-0.589*	*-0.714*	*-0.465*	*>0.001*

CI: Confidence Interval; **MAS-A:** Metacognition **Assessment Scale- Adapted**

Table 2: Bell et al. (1994) factor structure

MAS-A component	Beta coefficient	CI upper	CI lower	P value
Self-reflectivity	-0.028	-0.071	0.015	0.200
Understanding Others' Minds	-0.030	-0.091	0.032	0.344
Decentration	-0.045	-0.132	0.041	0.304
Mastery	*-0.071*	*-0.126*	*-0.016*	*0.011*
Total MAS-A	*-0.445*	*-0.528*	*-0.361*	*>0.001*

CI: Confidence Interval; **MAS-A:** Metacognition **Assessment Scale- Adapted**

Appendix 15: MEP groups sensitivity analysis

Table 1: IPDMA estimates of relationship between Self-reflectivity and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	-0.307	-0.662	0.047	0.090
PANSS-VDGNS	-0.012	-0.048	0.025	0.532
PANSS-BNS	-0.028	-0.072	0.017	0.219
Experiential Negative Symptoms	-0.001	-0.006	0.005	0.807
Expressive Negative Symptoms	-0.028	-0.062	0.006	0.110
Bell Cognitive Model	-0.027	-0.076	0.021	0.272
VDG Cognitive Model	-0.014	-0.053	0.025	0.472
Blunted Affect (N1)	-0.000	-0.003	0.002	0.797
Emotional withdrawal (N2)	-0.002	-0.006	0.003	0.474
Poor rapport (N3)	-0.003	-0.009	0.004	0.465
Passive/apathetic social withdrawal (N4)	-0.000	-0.002	0.002	0.957
Difficulty in abstract thinking (N5)	-0.001	-0.006	0.004	0.790
Lack of spontaneity and flow of conversation (N6)	-0.005	-0.012	0.003	0.244
Stereotyped thinking (N7)	-0.004	-0.013	0.005	0.423
Mannerisms and posturing (G5)	-0.000	-0.003	0.002	0.763
Motor retardation (G7)	-0.000	-0.003	0.002	0.794
Uncooperativeness (G8)	-0.001	-0.005	0.003	0.785
Poor attention (G11)	-0.001	-0.004	0.003	0.798
Disturbance of volition (G13)	-0.000	-0.003	0.002	0.896
Poor impulse control (G14)	-0.000	-0.004	0.003	0.833
Preoccupation (G15)	-0.000	-0.005	0.004	0.856
Active social avoidance (G16)	-0.001	-0.004	0.003	0.721

CI: Confidence Interval

PANSS-BNS: Positive and Negative Syndrome Scale (Bell et al., 1994) – Negative Subscale;

PANSS-ONS: Positive and Negative Syndrome Scale – Original Negative Subscale;

PANSS-VDGNS: Positive and Negative Syndrome Scale (Van der Gaag et al., 2006) – Negative Subscale

Table 2: IPDMA estimates of relationship between Understanding Others' Minds and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	-0.445	-0.906	0.016	0.059
PANSS-VDGNS	-0.029	-0.096	0.038	0.396
PANSS-BNS	-0.059	-0.138	0.020	0.145
Experiential Negative Symptoms	-0.003	-0.020	0.014	0.739
Expressive Negative Symptoms	-0.056	-0.119	0.007	0.079
Bell Cognitive Model	-0.016	-0.082	0.049	0.623
VDG Cognitive Model	-0.014	-0.084	0.055	0.685
Blunted affect (N1)	-0.000	-0.004	0.003	0.841
Emotional withdrawal (N2)	-0.005	-0.017	0.008	0.455
Poor rapport (N3)	-0.011	-0.026	0.005	0.176
Passive/apathetic social withdrawal (N4)	-0.001	-0.005	0.004	0.816
Difficulty in abstract thinking (N5)	-0.001	-0.007	0.005	0.785
Lack of spontaneity and flow of conversation (N6)	-0.006	-0.015	0.003	0.210
Stereotyped thinking (N7)	-0.001	-0.009	0.007	0.783
Mannerisms and posturing (G5)	-0.001	-0.005	0.004	0.772
Motor retardation (G7)	-0.001	-0.008	0.007	0.829
Uncooperativeness (G8)	-0.001	-0.008	0.006	0.791
Poor attention (G11)	-0.001	-0.006	0.005	0.820
Disturbance of volition (G13)	-0.002	-0.012	0.007	0.646
Poor impulse control (G14)	-0.000	-0.006	0.005	0.955
Preoccupation (G15)	-0.000	-0.004	0.003	0.890
Active social avoidance (G16)	-0.001	-0.006	0.005	0.857

CI: Confidence Interval

PANSS-BNS: Positive and Negative Syndrome Scale (Bell et al., 1994) – Negative Subscale;

PANSS-ONS: Positive and Negative Syndrome Scale – Original Negative Subscale;

PANSS-VDGNS: Positive and Negative Syndrome Scale (Van der Gaag et al., 2006) – Negative Subscale

Table 3: IPDMA estimates of relationship between Decentration and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	-0.396	-0.874	0.082	0.104
PANSS-VDGNS	-0.017	-0.080	0.046	0.602
PANSS-BNS	-0.046	-0.150	0.059	0.393
Experiential Negative Symptoms	0.001	-0.018	0.019	0.945
Expressive Negative Symptoms	-0.039	-0.111	0.033	0.288
Bell Cognitive Model	-0.030	-0.123	0.063	0.521
VDG Cognitive Model	-0.026	-0.119	0.067	0.585
Blunted affect (N1)	-0.000	-0.007	0.006	0.919
Emotional withdrawal (N2)	-0.005	-0.020	0.009	0.484
Poor rapport (N3)	-0.009	-0.030	0.012	0.393
Passive/apathetic social withdrawal (N4)	0.001	-0.007	0.008	0.878
Difficulty in abstract thinking (N5)	0.002	-0.016	0.019	0.863
Lack of spontaneity and flow of conversation (N6)	-0.004	-0.021	0.013	0.623
Stereotyped thinking (N7)	-0.000	-0.008	0.008	0.912
Mannerisms and posturing (G5)	-0.001	-0.009	0.008	0.900
Motor retardation (G7)	0.000	-0.010	0.010	0.993
Uncooperativeness (G8)	-0.001	-0.011	0.008	0.755
Poor attention (G11)	-0.001	-0.008	0.006	0.840
Disturbance of volition (G13)	-0.002	-0.017	0.012	0.742
Poor impulse control (G14)	-0.000	-0.006	0.005	0.871
Preoccupation (G15)	-0.000	-0.008	0.008	0.910
Active social avoidance (G16)	0.001	-0.010	0.011	0.815

CI: Confidence Interval

PANSS-BNS: Positive and Negative Syndrome Scale (Bell et al., 1994) – Negative Subscale;

PANSS-ONS: Positive and Negative Syndrome Scale – Original Negative Subscale;

PANSS-VDGNS: Positive and Negative Syndrome Scale (Van der Gaag et al., 2006) – Negative Subscale

Table 4: IPDMA estimates of relationship between Mastery and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	-0.483	-1.159	0.194	0.162
PANSS-VDGNS	-0.006	-0.029	0.018	0.628
PANSS-BNS	-0.021	-0.062	0.020	0.305
Experiential Negative Symptoms	-0.000	-0.004	0.004	0.898
Expressive Negative Symptoms	-0.015	-0.039	0.008	0.206
Bell Cognitive Model	-0.039	-0.086	0.008	0.107
VDG Cognitive Model	-0.041	-0.098	0.016	0.160
Blunted affect (N1)	-0.000	-0.003	0.002	0.800
Emotional withdrawal (N2)	-0.002	-0.009	0.004	0.475
Poor rapport (N3)	-0.005	-0.014	0.005	0.312
Passive/apathetic social withdrawal (N4)	0.000	-0.002	0.002	0.992
Difficulty in abstract thinking (N5)	-0.000	-0.004	0.003	0.826
Lack of spontaneity and flow of conversation (N6)	-0.006	-0.012	0.001	0.084
Stereotyped thinking (N7)	-0.001	-0.005	0.003	0.629
Mannerisms and posturing (G5)	-0.000	-0.003	0.002	0.777
Motor retardation (G7)	-0.000	-0.002	0.002	0.855
Uncooperativeness (G8)	-0.002	-0.007	0.004	0.568
Poor attention (G11)	-0.001	0.006	0.004	0.752
Disturbance of volition (G13)	-0.000	-0.003	0.002	0.843
Poor impulse control (G14)	-0.000	-0.003	0.003	0.978
Preoccupation (G15)	-0.000	-0.002	0.002	0.867
Active social avoidance (G16)	-0.000	-0.004	0.003	0.815

CI: Confidence Interval

PANSS-BNS: Positive and Negative Syndrome Scale (Bell et al., 1994) – Negative Subscale;

PANSS-ONS: Positive and Negative Syndrome Scale – Original Negative Subscale;

PANSS-VDGNS: Positive and Negative Syndrome Scale (Van der Gaag et al., 2006) – Negative Subscale

Table 5: IPDMA estimates of relationship between Total Metacognition and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	*-0.666*	*-0.864*	*-0.469*	*>0.001*
PANSS-VDGNS	*-0.385*	*-0.528*	*-0.242*	*>0.001*
PANSS-BNS	*-0.433*	*-0.552*	*-0.315*	*>0.001*
Experiential Negative Symptoms	*-0.086*	*-0.148*	*-0.023*	*0.007*
Expressive Negative Symptoms	*-0.278*	*-0.346*	*-0.210*	*>0.001*
Bell Cognitive Model	*-0.421*	*-0.515*	*-0.328*	*>0.001*
Van der Gaag Cognitive Model	*-0.565*	*-0.718*	*-0.412*	*>0.001*
Blunted affect (N1)	*-0.068*	*-0.102*	*-0.034*	*>0.001*
Emotional withdrawal (N2)	*-0.069*	*-0.093*	*-0.045*	*>0.001*
Poor rapport (N3)	*-0.076*	*-0.097*	*-0.055*	*>0.001*
Passive/apathetic social withdrawal (N4)	*-0.030*	*-0.053*	*-0.007*	*0.010*
Difficulty in abstract thinking (N5)	*-0.064*	*-0.088*	*-0.040*	*>0.001*
Lack of spontaneity and flow of conversation (N6)	*-0.1007*	*-0.138*	*-0.064*	*>0.001*
Stereotyped thinking (N7)	*-0.076*	*-0.097*	*-0.055*	*>0.001*
Mannerisms and posturing (G5)	*-0.044*	*-0.0.61*	*-0.026*	*>0.001*
Motor retardation (G7)	*-0.035*	*-0.054*	*-0.015*	*0.001*
Uncooperativeness (G8)	*-0.046*	*-0.062*	*-0.031*	*>0.001*
Poor attention (G11)	*-0.043*	*-0.064*	*-0.021*	*>0.001*
Disturbance of volition (G13)	*-0.039*	*-0.072*	*-0.005*	*0.024*
Poor impulse control (G14)	-0.001	-0.024	0.021	0.903
Preoccupation (G15)	*-0.028*	*-0.056*	*0.001*	*0.057*
Active social avoidance (G16)	-0.005	-0.037	0.027	0.770

CI: Confidence Interval

PANSS-BNS: Positive and Negative Syndrome Scale (Bell et al., 1994) – Negative Subscale;

PANSS-ONS: Positive and Negative Syndrome Scale – Original Negative Subscale;

PANSS-VDGNS: Positive and Negative Syndrome Scale (Van der Gaag et al., 2006) – Negative Subscale

Appendix 16: Data configuration sensitivity analyses

Using K-Means clustering, two groups with high metacognition and low negative symptoms, and vice versa were identified. Comparing these groups across studies in meta-analyses showed similar results to the original analyses, where negative symptom difficulties were more strongly associated with the low metacognition, high negative symptom group. These are summarised in Table 1 below.

Table 1: IPDMA results comparing relationship between high metacognition low negative symptom, and low metacognition high negative symptom clusters

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	*-8.839*	*-10.575*	*-7.102*	*>0.001*
PANSS-VDGNS	*-9.484*	*-12.275*	*-6.694*	*>0.001*
PANSS-BNS	*-9.057*	*-11.642*	*-6.472*	*>0.001*
Experiential Negative Symptoms	*-3.248*	*-4.253*	*-2.243*	*>0.001*
Expressive Negative Symptoms	*-5.2765*	*-6.542*	*-4.011*	*>0.001*
Blunted affect (N1)	*-1.436*	*-1.847*	*-1.024*	*>0.001*
Emotional withdrawal (N2)	*-1.2632*	*-1.568*	*-0.958*	*>0.001*
Poor rapport (N3)	*-1.458*	*1.901*	*-1.015*	*>0.001*
Passive/apathetic social withdrawal (N4)	*-1.048*	*-1.350*	*-0.745*	*>0.001*
Difficulty in abstract thinking (N5)	*-0.840*	*-1.141*	*-0.539*	*>0.001*
Lack of spontaneity and flow of conversation (N6)	*-1.493*	*-1.876*	*-1.109*	*>0.001*
Stereotyped thinking (N7)	*-0.824*	*-1.111*	*-0.538*	*>0.001*
Mannerisms and posturing (G5)				
Motor retardation (G7)	*-0.772*	*-1.047*	*-0.497*	*>0.001*
Uncooperativeness (G8)	*-0.500*	*-0.739*	*-0.260*	*>0.001*
Poor attention (G11)	*-0.529*	*-0.815*	*-0.244*	*>0.001*
Disturbance of volition (G13)	*-0.676*	*-1.043*	*-0.309*	*>0.001*
Poor impulse control (G14)	-0.092	-0.366	0.183	0.513
Preoccupation (G15)	-0.511	-0.790	-0.233	>0.001
Active social avoidance (G16)	*-0.5779*	*-0.899*	*-0.257*	*>0.001*

CI: Confidence Interval

PANSS-BNS: Positive and Negative Syndrome Scale (Bell et al., 1994) – Negative Subscale;

PANSS-ONS: Positive and Negative Syndrome Scale – Original Negative Subscale;

PANSS-VDGNS: Positive and Negative Syndrome Scale (Van der Gaag et al., 2006) – Negative Subscale

Sensitivity analyses looking at feature scaling the data to account for variation in unit-range across metacognition scales showed a similar pattern of results to the

original meta-analyses, regardless of whether range normalisation (0-100) or z-score standardisation was used. Only test analyses (using the Bell et al. (1994) negative symptoms scale) were conducted to determine whether these computations had any significant effect on the impact unit differences made on the subscale versus total scale results and these findings demonstrate that the margins of difference between beta coefficients for subscales and the total scale mirror those in the original analyses. As a result this sensitivity analyses was halted and no further analyses conducted.

Table 2: Feature Scaling Testing using Bell et al. (1994) negative symptoms factor structure

Method of feature scaling	Metacognitive Scale	Beta coefficient	CI Upper	CI Lower	P value
Min-max normalisation (0-100)	Self-Reflectivity	-0.003	-0.007	0.001	0.151
	Understanding Others' Minds	-0.004	-0.009	0.001	0.115
	Decentration	-0.002	-0.005	0.001	0.280
	Mastery	-0.002	-0.006	0.001	0.200
	Total Metacognition	***-0.134***	***-0.172***	***-0.095***	***>0.001***
Standardisation	Self-Reflectivity	-0.009	-0.020	0.002	0.126
	Understanding Others' Minds	-0.011	-0.023	0.002	0.089
	Decentration	-0.008	-0.020	0.005	0.243
	Mastery	-0.010	-0.023	0.003	0.144
	Total Metacognition	***-0.358***	***-0.436***	***-0.280***	***>0.001***

CI: Confidence Interval

Appendix 17: Covariate sensitivity analyses

Table 1: IPDMA estimates of relationship between Self-reflectivity and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	*-0.389*	*-0.652*	*-0.126*	*0.003*
Expressive Negative Symptoms	*-0.054*	*-0.097*	*-0.010*	*0.015*

CI: Confidence Interval; **PANSS-ONS:** Positive and Negative Syndrome Scale – Original Negative Subscale

Table 2: IPDMA estimates of relationship between Understanding Others' Minds and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	*-0.528*	*-0.861*	*-0.195*	*0.002*

CI: Confidence Interval; **PANSS-ONS:** Positive and Negative Syndrome Scale – Original Negative Subscale

Table 3: IPDMA estimates of relationship between Mastery and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
Bell Cognitive Model	*-0.152*	*-0.246*	*-0.058*	*0.001*
Van der Gaag Cognitive Model	*-0.208*	*-0.333*	*-0.083*	*0.001*
Lack of spontaneity and flow of conversation (N6)	-0.010	-0.020	0.001	0.081

CI: Confidence Interval

Table 4: IPDMA estimates of relationship between Total Metacognition and individual Negative Symptoms

Negative Symptom Item(s)	Beta coefficient	CI Upper	CI Lower	P value
PANSS-ONS	*-0.211*	*-0.359*	*-0.064*	*0.005*
PANSS-VDGNS	-0.024	-0.051	0.002	0.073
PANSS-BNS	*-0.056*	*-0.093*	*-0.019*	*0.003*
Experiential Negative Symptoms	-0.001	-0.003	0.002	0.666
Expressive Negative Symptoms	*-0.032*	*-0.053*	*-0.012*	*0.002*
Bell Cognitive Model	*-0.048*	*-0.075*	*-0.021*	*<0.001*
Van der Gaag Cognitive Model	*-0.072*	*-0.116*	*-0.028*	*0.001*
Blunted affect (N1)	-0.000	-0.002	0.001	0.618
Emotional withdrawal (N2)	-0.005	-0.010	0.000	0.058
Poor rapport (N3)	*-0.008*	*-0.013*	*-0.003*	*0.003*
Passive/apathetic social withdrawal (N4)	-0.000	-0.001	0.000	0.914
Difficulty in abstract thinking (N5)	-0.001	-0.004	0.001	0.368
Lack of spontaneity and flow of conversation (N6)	*-0.009*	*-0.017*	*-0.002*	*0.010*
Stereotyped thinking (N7)	*-0.005*	*-0.009*	*-0.000*	*0.034*
Mannerisms and posturing (G5)	-0.000	-0.002	0.001	0.570
Motor retardation (G7)	-0.001	-0.003	0.001	0.370
Uncooperativeness (G8)	-0.001	-0.003	0.001	0.299
Poor attention (G11)	-0.000	-0.002	0.001	0.756
Disturbance of volition (G13)	-0.000	-0.001	0.001	0.914
Preoccupation (G15)	-0.001	-0.003	0.002	0.666

CI: Confidence Interval

PANSS-BNS: Positive and Negative Syndrome Scale (Bell et al., 1994) – Negative Subscale;

PANSS-ONS: Positive and Negative Syndrome Scale – Original Negative Subscale;

PANSS-VDGNS: Positive and Negative Syndrome Scale (Van der Gaag et al., 2006) – Negative Subscale

Appendix 18: Ethics approvals for study 3

University of Glasgow communication

Nicola McGuire (PGR)

From: MVLS Ethics Admin
Sent: 05 February 2021 12:13
To: Nicola McGuire (PGR); MVLS Ethics Admin
Subject: RE: New study query

Hi Nicola

If NHS has confirmed they don't need to review it, and the proposed research is in keeping with the original consent, then MVLS ethics don't need to review either.

Regards
Neil

Neil Allan
MVLS Ethics Committee Administrator

Direct line: 0141 330 5206
email is the only reliable form of contact at this time

Institute of Infection, Immunity & Inflammation
College of Medical, Veterinary & Life Sciences
Glasgow Biomedical Research Centre
Room 314, Sir Graeme Davies Building
University of Glasgow
120 University Place
Glasgow G12 8TA
The University of Glasgow, charity number SC004401

From: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Sent: 04 February 2021 10:37
To: MVLS Ethics Admin <mvls-ethics-admin@glasgow.ac.uk>
Subject: New study query

Dear Neil,

I have been advised by Emma-Jane Gault from research governance to contact you about a new study I am wishing to set up. I have attached the protocol here alongside the variables I would request access to but in short, I am interested in conducting secondary data analyses of a fully anonymised and delinked existing dataset.

The data is held by the University of Glasgow and, as it is of persons who were NHS patients at the time, I have confirmed with Judith Goddan from the Research Ethics Committee in the NHS that this doesn't require NHS ethical review. Can you tell me whether MVLS ethical approval would be required? We believe the purpose of the research is inkeeping with the original consent and no new ethical issues are raised.

If you need any further information to advise please just let me know.

Best Wishes,

Nicola

West of Scotland ethics committee communication

Nicola McGuire (PGR)

From: Godden, Judith <Judith.Godden@ggc.scot.nhs.uk>
Sent: 29 January 2021 16:16
To: Nicola McGuire (PGR)
Subject: RE: New Study Query

If you are using purely anonymous archival material from the original study then no further ethical review should be required unless the data is such that identification could be possible.
Please ensure that it is clear in any publication that only fully anonymous data was accessed for this study.

Kind regards

Judith

Dr Judith Godden
Scientific Officer/ Manager
West of Scotland Research Ethics Service

From: Nicola McGuire (PGR) [mailto:n.mcguire.1@research.gla.ac.uk]
Sent: 29 January 2021 15:53
To: Godden, Judith <Judith.Godden@ggc.scot.nhs.uk>
Subject: [ExternaltoGGC]RE: New Study Query

Hi Judith,

My apologies for poor phrasing, the data was delinked when it was archived and there are no identifiers associated with the dataset. I've confirmed this with Professor Gumley.

Best Wishes,

Nicola

From: Godden, Judith <Judith.Godden@ggc.scot.nhs.uk>
Sent: 29 January 2021 15:43
To: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Subject: RE: New Study Query

HI Nicola
I am not clear if the data now held is completely anonymous archival material as you also talk about it having to be de-linked from identifiers suggesting that the data has still got identifiers associated with it. This is key to whether there is a need for ethical review.

Thanks

Judith

Appendix 18

Dr Judith Godden
Scientific Officer/ Manager
West of Scotland Research Ethics Service

From: Nicola McGuire (PGR) [mailto:n.mcguire.1@research.gla.ac.uk]
Sent: 29 January 2021 10:55
To: Godden, Judith <Judith.Godden@ggc.scot.nhs.uk>
Subject: [ExternaltoGGC]New Study Query

Dear Judith,

I've been advised by Emma-Jane Gault to contact you regarding a new study I am wishing to set up. I have attached the protocol here but in short, we are interested in conducting an analysis of an existing dataset. The data collection was sponsored by NHS GG&C and the end of study notification form was submitted. The reference is REC: 04/S0703/91 in case it is helpful to you.

The data is now held by the University of Glasgow in an anonymised format. I've included here the variables that I would be requesting access to and these data would be anonymised and de-linked from any other participant identifiers.

Can you tell me whether REC ethical approval would be needed? Of course if you need more information to assess please let me know.

Best Wishes,

Nicola

Appendix 19: Simple linear regressions – study 3

Table 1

Variable	R^2	F	DF	P	Predictors	ß	SE	P value	Confint (2.75%)	Confint (97.5%)	Group Differences	ß	SE	P value
Total Negative Symptoms (Time 1)	**0.135**	**3.912**	**50**	**0.026**	Avoidant	0.318	0.171	0.078	-0.035	0.651	D – Se	0.308	0.171	0.177
					Preoccupied	-0.225	0.218	0.307	-0.664	0.213	Pr – Se	-0.225	0.218	0.558
											Pr - D	**-0.533**	**0.204**	**0.031**
Expressive Deficits (Time 1)	**0.116**	**3.281**	**50**	**0.046**	Avoidant	0.327	0.164	0.052	-0.003	1.954	D - Se	0.327	0.164	0.124
					Preoccupied	-0.100	0.210	0.634	-0.522	0.321	Pr - Se	-0.100	0.210	0.881
											Pr - D	-0.427	0.196	0.083
Experiential Deficits (Time 1)	**0.048**	**1.262**	**50**	**0.010**	Avoidant	0.211	0.171	0.225	-0.133	0.554	D - Se	0.211	0.171	0.439
					Preoccupied	-0.066	0.219	0.762	-0.506	0.373	Pr - Se	-0.066	0.219	0.950
											Pr - D	-0.277	0.204	0.369
Service Engagement (Time 1)	0.020	0.443	44	0.645	Avoidant	2.540	2.792	0.368	-3.087	8.167	D - Se	2.540	0.792	0.635
					Preoccupied	2.400	3.404	0.484	-4.460	9.260	Pr - Se	2.400	3.404	0.760
											Pr - D	-0.140	2.975	0.999
MAS-A Total	**0.266**	**9.048**	**50**	**>0.001**	**Avoidant**	**-2.707**	**1.062**	**0.014**	**-4.840**	**-0.574**	D – Se	**-2.707**	**1.062**	**0.036**
					Preoccupied	2.435	1.357	0.079	-0.291	5.162	Pr – Se	2.435	1.357	0.180
											Pr - D	**5.142**	**1.267**	**<0.001**
Self-Reflectivity	**0.293**	**10.36**	**50**	**>0.001**	**Avoidant**	**-1.108**	**0.409**	**0.009**	**-1.928**	**-0.287**	D – Se	-1.108	0.409	0.239
					Preoccupied	1.012	0.522	0.058	-0.037	2.060	Pr – Se	1.012	0.522	0.137
											Pr - D	**2.119**	**0.487**	**<0.001**
UOM	**0.127**	**3.621**	**50**	**0.034**	Avoidant	-0.618	0.316	0.056	-1.251	0.016	D – Se	-0.618	0.316	0.132
					Preoccupied	0.282	0.403	0.487	-0.527	1.092	Pr – Se	0.282	0.403	0.763
											Pr - D	0.900	0.376	0.052
Decentration	**0.268**	**9.143**	**50**	**>0.001**	**Avoidant**	**-0.515**	**0.188**	**0.009**	**-0.893**	**-0.137**	D – Se	**-0.515**	**0.188**	**0.023**
					Preoccupied	0.385	0.241	0.115	-0.098	0.868	Pr – Se	0.385	0.241	0.252
											Pr - D	**0.900**	**0.225**	**<0.001**
Mastery	**0.165**	**4.931**	**50**	**0.011**	Avoidant	-0.467	0.329	0.162	-1.129	0.194	D – Se	-0.467	0.329	0.337
					Preoccupied	0.756	0.421	0.078	-0.089	1.601	Pr – Se	0.756	0.421	0.179
											Pr - D	**1.22**	**0.393**	**0.008**
Reflective Functioning	**0.292**	**10.51**	**51**	**<0.001**	**Avoidant**	**-2.172**	**0.539**	**<0.001**	**-3.255**	**-1.089**	D – Se	**-2.172**	**0.539**	**<0.001**
					Preoccupied	-0.032	0.669	0.962	-1.375	1.311	Pr – Se	-0.032	0.669	0.999
											Pr - D	**2.140**	**0.622**	**0.003**

Table 1 Cont

Variable	R^2	F	DF	P	Predictors	ß	SE	P value	Confint (2.75%)	Confint (97.5%)	Group Differences	ß	SE	P value
Total Negative Symptoms (Time 2)	**0.264**	**5.501**	**46**	**0.003**	Avoidant	0.086	0.139	0.540	-0.194	0.367	D – Se	0.086	0.139	0.810
					Preoccupied	0.723	0.170	0.672	-0.269	0.414	Pr – Se	0.072	0.170	0.904
					Total Negative Symptoms (Time 1)	**0.389**	**0.108**	**<0.001**	**0.172**	**0.607**	**Pr - D**	-0.014	0.168	0.996
Expressive Deficits (Time 2)	**0.227**	**4.503**	**46**	**0.007**	Avoidant	0.150	0.151	0.326	-0.154	0.454	D – Se	0.327	0.164	0.124
					Preoccupied	0.047	0.257	0.799	-0.320	0.414	Pr – Se	-0.100	0.210	0.881
					Expressive Deficits (Time 1)	**0.366**	**0.122**	**0.004**	**0.121**	**0.610**	**Pr - D**	-0.427	0.196	0.833
Experiential Deficits (Time 2)	**0.183**	**3.444**	**46**	**0.024**	Avoidant	0.115	0.171	0.504	-0.229	-0.459	D – Se	0.115	0.171	0.779
					Preoccupied	0.011	0.209	0.957	-0.409	0.432	Pr – Se	0.011	0.054	0.998
					Experiential Deficits (Time 1)	**0.386**	**0.136**	**0.007**	**0.112**	**0.659**	**Pr - D**	-0.104	0.199	0.861
Service Engagement (Time 2)	**0.328**	**5.692**	**35**	**0.003**	Avoidant	-3.289	3.234	0.316	-9.855	3.277	D – Se	2.540	2.792	0.635
					Preoccupied	-4.843	3.760	0.206	-12.477	2.791	Pr – Se	2.400	3.404	0.760
					Service Engagement (Time 1)	**0.708**	**0.173**	**<0.001**	**0.357**	**1.060**	**Pr - D**	-0.140	2.975	0.999

DF: Degrees of Freedom; **SE**: Standard Error; **Confint:** Confidence Interval; **MAS-A:** Metacognition Assessment Scale - Adapted; **UOM:** Understanding Others' Minds; **A:** Avoidant; **Se:** Secure; **Pr:** Preoccupied

Appendix 20: Standardised estimates for study 3 path models

Outcome	Model	Iterations to Converge	Chi Square Statistic	DF	P Value	CFI	AIC	RMSEA	CI Low	CI High	P Value	SRMR
Total Negative Symptoms Time 1	1	44	4.513	3	0.211	0.964	867.565	0.098	>0.001	0.271	0.263	0.058
	2	37	39.092	4	>0.001	0.538	1015.893	0.411	0.299	0.533	>0.001	0.262
Total Negative Symptoms Time 2	1	48	5.901	7	0.551	1	1159.514	>0.001	>0.001	0.158	0.63	0.069
	2	38	36.591	8	>0.001	0.629	1299.465	0.27	0.185	0.362	>0.001	0.219
Expressive Deficits Time 1	1	40	4.962	3	0.175	0.953	798.149	0.112	>0.001	0.281	0.222	0.066
	2	39	39.541	4	>0.001	0.526	946.477	0.413	0.302	0.535	>0.001	0.264
Expressive Deficits Time 2	1	44	6.153	7	0.522	1	1038.444	>0.001	>0.001	0.162	0.603	0.078
	2	44	36.844	8	<0.001	0.609	1178.394	0.271	0.186	0.363	>0.001	0.222
Experiential Deficits Time 1	1	40	3.298	3	0.348	0.993	777.686	0.044	>0.001	0.242	0.406	0.052
	2	38	37.877	4	>0.001	0.551	926.014	0.404	0.292	0.526	>0.001	0.261
Experiential Deficits Time 2	1	43	4.877	7	0.675	1	1002.079	>0.001	>0.001	0.139	0.741	0.068
	2	39	35.568	8	>0.001	0.622	1142.029	0.265	0.18	0.357	>0.001	0.218
Service Engagement Time 1	1	43	3.465	3	0.325	0.987	742.731	0.058	>0.001	0.262	0.376	0.063
	2	41	28.536	4	>0.001	0.589	867.98	0.365	0.246	0.497	>0.001	0.239
Service Engagement Time 2	1	45	10.779	7	0.149	0.916	879.746	0.119	>0.001	0.251	0.197	0.077
	2	38	29.151	8	>0.001	0.661	981.319	0.264	0.165	0.37	0.001	0.22

Key	
Green	Acceptable fit statistics
Orange	Fit statistics only regarded as acceptable in some literature
Red	Unacceptable fit statistics

CFI: Comparative Fit Index; **AIC:** Akaike Information Criterion; **RMSEA:** Root mean square error of approximation; **CI Low:** lower bound confidence interval; **CI High:** Upper bound confidence interval; **SRMR:** Standardised Root Mean Square Residual

Appendix 21: Path model estimates

Table 1: Parameter estimates for relationships across negative symptom path models

Path Model	Variables Compared	Estimate (ß/Cov)	SE	P-Value	95%CI Lower	95% CI Upper
Total Negative Symptoms Time 1	Reflective Function ~ TNST1	0.438	0.938	0.641	-1.401	2.277
	Metacognition ~ TNST1	-0.563	0.397	0.156	-1.341	0.214
	Secure ~ TNST1	2.818	2.907	0.332	-2.878	8.515
	Avoidant ~ TNST1	**6.360**	**2.789**	**0.023**	**0.894**	**11.826**
Total Negative Symptoms Time 2	**TNST1 ~ TNST2**	0.373	0.106	>0.001	0.164	0.581
	Reflective Function ~ TNST1	0.375	0.947	0.692	-1.481	2.232
	Metacognition ~ TNST1	-0.569	0.397	0.152	-1.346	0.209
	Secure ~ TNST1	2.769	3.013	0.358	-3.137	8.675
	Avoidant ~ TNST1	**6.655**	**2.837**	**0.019**	**1.096**	**12.215**
Expressive Deficits Time 1	Reflective Function ~ ExpresT1	0.267	0.451	0.555	-0.618	1.151
	Metacognition ~ ExpresT1	-0.220	0.208	0.289	-0.628	0.187
	Secure ~ ExpresT1	0.823	0.663	0.507	-1.609	3.256
	Avoidant ~ ExpresT1	**3.258**	**1.220**	**0.008**	**0.866**	**5.650**
Expressive Deficits Time 2	**ExpressT1 ~ ExpresT2**	**0.381**	**0.124**	**0.002**	**0.138**	**0.624**
	Reflective Function ~ ExpresT1	0.229	0.454	0.614	-0.661	1.119
	Metacognition ~ ExpresT1	-0.221	0.208	0.288	-0.628	0.186
	Secure ~ ExpresT1	0.890	1.289	0.490	-1.637	3.416
	Avoidant ~ ExpresT1	**3.362**	**1.244**	**0.007**	**0.923**	**5.800**
Experiential Deficits Time 1	Reflective Function ~ ExperT1	0.357	0.356	0.317	-0.341	1.055
	Metacognition ~ ExperT1	**-0.347**	**0.150**	**0.020**	**-0.640**	**-0.054**
	Secure ~ ExperT1	-0.392	0.798	0.623	-1.957	1.173
	Avoidant ~ ExperT1	**-2.564**	**0.697**	**>0.001**	**-3.930**	**-1.198**
Experiential Deficits Time 2	**ExperT1 ~ ExperT2**	**0.346**	**0.125**	**0.006**	**0.100**	**0.591**
	Reflective Function ~ ExperT1	0.336	0.361	0.353	-0.372	1.043
	Metacognition ~ ExperT1	**-0.352**	**0.151**	**0.020**	**-0.648**	**-0.056**
	Secure ~ ExperT1	0.493	1.303	0.705	-2.061	3.048
	Avoidant ~ ExperT1	1.951	1.208	0.106	-0.416	4.318
Parameters expressed in all negative symptoms models at Time 1	Secure ~ Reflective Function	-0.392	0.798	0.623	-1.957	1.173
	Avoidant ~ Reflective Function	**-2.564**	**0.697**	**>0.001**	**-3.930**	**-1.198**
	Secure ~ Metacognition	-2.402	1.461	0.100	-5.265	0.461
	Avoidant ~ Metacognition	-5.109	1.265	>0.001	-7.588	-2.630
	Reflective Function ~~ Metacognition	2.127	0.821	0.010	0.519	3.736
Parameters expressed in all negative symptoms models at Time 1	Secure ~ Reflective Function	-0.333	0.814	0.682	-1.928	1.261
	Avoidant ~ Reflective Function	**-2.500**	**0.704**	**>0.001**	**-3.879**	**-1.121**
	Secure ~ Metacognition	-2.385	1.499	0.111	-5.323	0.552
	Avoidant ~ Metacognition	**-5.042**	**1.287**	**>0.001**	**-7.563**	**-2.520**
	Reflective Function ~~ Metacognition	**2.224**	**0.862**	**0.010**	**0.534**	**3.915**

TNST1/TNST2 – Total Negative Symptoms Time 1/2; ExpresT1/ExpresT2 – Expressive Negative Symptoms Time 1/2; ExperT1/ExperT2 – Experiential Negative Symptoms Time 1/2; text in bold where $p<0.001$

Table 2: Parameter estimates for relationships across service engagement path models

Path Model	Variables Compared	Estimate (β/Cov)	SE	P-Value	95%CI Lower	95% CI Upper
Service Engagement Time 1	Reflective Function ~ SEngageT1	-0.519	0.767	0.499	-2.021	0.984
	Metacognition ~ SEngageT1	-0.463	0.350	0.185	-1.148	0.222
	Secure ~ SEngageT1	-3.768	3.421	0.271	-10.472	2.937
	Avoidant ~ SEngageT1	-3.407	3.515	0.332	-10.296	3.482
	Secure ~ Reflective Function	0.361	0.782	0.644	-1.172	1.894
	Avoidant ~ Reflective Function	**-2.089**	**0.634**	**0.001**	**-3.332**	**-0.846**
	Secure ~ Metacognition	-2.903	1.604	0.070	-6.047	0.242
	Avoidant ~ Metacognition	**-4.864**	**1.247**	**>0.001**	**-7.309**	**-2.420**
	Reflective Function ~~ Metacognition	**2.092**	**0.870**	**0.016**	**0.386**	**3.798**
Service Engagement Time 2	**SEngageT2 ~ SEngageT1**	**0.646**	**0.209**	**0.002**	**0.237**	**1.055**
	Reflective Function ~ SEngageT2	-0.466	0.809	0.564	-2.054	1.119
	Metacognition ~ SEngageT2	-0.609	0.357	0.088	-1.308	0.090
	Secure ~ SEngageT2	**-8.029**	**3.194**	**0.012**	**-14.288**	**-1.769**
	Avoidant ~ SEngageT2	-4.109	3.302	0.213	-10.581	2.363
	Secure ~ Reflective Function	-0.111	0.887	0.900	-1.851	1.628
	Avoidant ~ Reflective Function	**-2.238**	**0.692**	**0.001**	**-3.594**	**-0.882**
	Secure ~ Metacognition	**-4.090**	**1.813**	**0.024**	**-7.643**	**-0.538**
	Avoidant ~ Metacognition	**-5.122**	**1.353**	**>0.001**	**-7.773**	**-2.471**
	Reflective Function ~~ Metacognition	**2.057**	**0.934**	**0.028**	**0.226**	**3.889**

SEngageT1/SEngageT2 – Service Engagement Time 1/2

Appendix 22: MAS-A calibration

Table 1: Summary of calibration ratings for each transcript

Metacognitive Component		Self Reflectivity		Understanding Others' Minds		Decentration		Mastery	
Rater Initials		N.M	H.M	N.M	H.M	N.M	H.M	N.M	H.M
Round One	Transcript 1	7	7	5	5	2	2	2	4
	Transcript 2	7	7	4	5	0	2	3	2.5
	Transcript 3	5	5	4	5	1	2	5	5
Round Two	Transcript 4	4	4.5	5	4.5	1	1.5	4	4
	Transcript 5	5	5	4.5	3	3	2	6.5	4
	Transcript 6	7	5	4.5	3.5	1	1.5	5	5
Round Three	Transcript 7	5	4.5	3	3	2	2	4	3.5
	Transcript 8	5	3	3.5	2.5	1	2	2	2
Round Four	Transcript 9	8	5.5	5	5	2	2	5	4
	Transcript 10	5.5	5	3	5	1	1	3	3
	Transcript 11	3	3.5	2	4.5	0.5	1.5	3	3
	Transcript 12	3.5	5	2	3	1	1	3	3.5

Yellow - Discrepant ratings less than gold standard (1 unit) unacceptable discrepancy

Amber - Ratings at gold standard (1 unit) unacceptable discrepancy

Red - Ratings exceeding gold standard (1 unit) unacceptable discrepancy

	Self-Reflectivity	Understanding Others' Minds	Decentration	Mastery	Total
Calibrated to rater 1 score	6	1	2	2	11
Calibrated to midpoint	1	1	3	1	6
Calibrated to rater 2 score	1	7	2	3	13

Summary of calibration challenges

There were fewer discrepancies which were rated unacceptable as per procedures for gold-standard calibration on the MAS-A than those scores rated the same or within tolerance between raters. In resolving discrepancies, ratings were most often calibrated to rater one or two, and less often to a midpoint between both raters' scores. Most consistently, self-reflectivity was re-graded consistently with rater one scores, whereas understanding others' minds were recalibrated to rater two's scores. Decentration was most often calibrated to a

midpoint and mastery was relatively more evenly split. It is not possible to reliably analyse these calibration decisions to determine the likelihood they were due to chance due to a small sample of co-rated transcripts, however it is possible that raters had biases towards certain components of the MAS-A and perhaps argued a stronger case for these domains than the other rater. Given that recalibration overall were distributed relatively equally between raters it is less likely that a power imbalance given the difference in raters' career stage and familiarity with the MAS-A influenced these findings.

There were few specific challenges to rating metacognition. The raters identified several elements of transcripts where it was difficult to differentiate whether they best represented examples of making inference about anothers' mental state (scored five on the Understanding Others' Minds scale), or levels of decentration that demonstrate when others have validly different interpretations of the world (scored 2). These difficulties did not specifically pertain to discrepancies in rating, but do demonstrate the complexity of the material when rating these complex structures. Furthermore as mastery is the only subscale which is non-hierarchical if data in a transcript demonstrates high levels of mastery which are not identified by a rater in error, this can lead to large discrepancies between raters. Large discrepancies can perhaps then more likely be attributed to error as opposed to other subscales where large discrepancies between raters would require several hierarchical components of metacognition to be missed in error by one rater for them to rate low when another rater might rate high.

Appendix 23: Approvals for study 4

South east Scotland research ethics service communication

Nicola McGuire (PGR)

From: Clearie, Joyce <Joyce.Clearie@nhslothian.scot.nhs.uk> on behalf of sesres, <sesres@nhslothian.scot.nhs.uk>
Sent: 22 April 2021 11:37
To: Nicola McGuire (PGR) Subject: RE: Data Study Query

Dear Nicola
Apologies for the delay .
Helen Newbery has now looked at your query and provided me with some advice to forward onto you.

Overall she advised that SESRES is not really best placed to help you here, especially given that the original study is closed with us. As such there is no mechanism to notify REC of what you propose to do. (I personally cannot find any record on our database for study with REC reference: 17/SS/0116)
She suspects as you probably found that the HRA decision tool is not that much help either as this is not really one of those "is this research?" questions, it is more about process.

She thinks if you look at the original IRAS REC form it states at Q15 :

15. Do you wish to seek generic ethical approval for research projects using the stored data, under conditions agreed with the REC, without requirement for researchers to apply individually to the REC for approval? Yes

So from this (assuming the original study got a FO), she thinks it would look as if you are covered from a REC perspective.
However, she advised that you need to ensure NHS Lothian Information Governance are also happy with what you wants to do, and also that the original sponsor are also happy. We cannot answer for either of these (and indeed, need to be neutral).
She comments that it is interesting that you say it is sponsored by University of Edinburgh, as there is no sponsor sign-off on the IRAS form (just the data custodian). It's a bit of a gap but research databases do not have sponsors.

So unfortunately we are not able to be of any more help to you and can only suggest that you take forward this matter with information governance.

Kind regards
SESRES
On behalf of Helen Newbery.

From: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Sent: 13 April 2021 10:02
To: sesres, <sesres@nhslothian.scot.nhs.uk>
Subject: RE: Data Study Query

Hello,

I sent an enquiry in the email chain below just over a month ago and unfortunately I've not been able to find out the necessary info to determine whether my research requires REC review or not. I'm wondering if anyone would be able to take another look at this or perhaps send a prompt to Helen Newbery who I believe it was initially passed to on my behalf? I've taken all the other suggested steps including the HRA tool and contacting the R&D dept but unfortunately I'm no further forward.

I understand you will be extremely busy with other queries, but I would really appreciate it as I'm a PhD student with some time-sensitive deadlines for gaining approvals to use this data. Just incase it isn't easy to locate in the email chain – the enquiry is as follows:

My name is Nicola McGuire and I am a PhD student at the University of Glasgow. I have been advised to contact you to query use of anonymous archival data for a data study and whether NHS ethical review is required.

The data was collected from NHS Lothian and sponsored by University of Edinburgh, and the end of study notification form has been submitted. The reference is REC: 17/SS/0116 in case it is helpful to you.

The data is held by University of Edinburgh in an anonymised format. I have attached here the data items that I would be requesting, but in short I would be interested in the use of anonymised archival demographic information, questionnaire and interview score data and the anonymised raw transcripts which would be coded to create an additional interview score. The overarching aim of this proposed study is to identify whether findings in an ongoing data study are replicable in a novel dataset.

Can you tell me whether REC ethical approval would be required? Of course if you need more information to assess please let me know.

Best Wishes,

Nicola McGuire (she/her)
PhD Student

Glasgow Mental Health Research Facility
Institute of Health and Wellbeing
University of Glasgow
Fleming Pavilion
West of Scotland Science Park (Todd Campus)
Glasgow, G20 0XA

twitter: @nicolamcguire_ wordpress: pavlovsdug.wordpress.com
email: n.mcguire.1@research.gla.ac.uk

From: Nicola McGuire (PGR)
Sent: 29 March 2021 11:58
To: sesres, <sesres@nhslothian.scot.nhs.uk>
Subject: RE: Data Study Query

Dear Helen,

I just wanted to check in about whether you would be able to have a look over this query if you haven't already? Joyce has given me some very helpful advice but I can't definitely say for certain from the HRA tool whether my research will require REC opinion because it is using archival data.

If you need any further information from me please let me know.

Best Wishes,

Nicola

From: Clearie, Joyce <Joyce.Clearie@nhslothian.scot.nhs.uk> On Behalf Of sesres,
Sent: 16 March 2021 12:10
To: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Subject: RE: Data Study Query

Dear Nicola
Apologies for some delay in responding to your email.
I have already forwarded your specific query to my line manager Helen Newbery for her consideration as she will be best placed to answer this. However she is on leave at the moment returning this Thursday so hopefully she will get back to you in due course on your more specific queries .

But to help you in the meantime queries as to whether or not a project would be defined as research/service evaluation or audit etc and if a study would need a REC opinion can often be helped by you using the process that is available on the HRA website where there is a HRA decision tool. Which might help you to get a definitive answer on this and other areas there where you can get useful advice.
Please use link below.
http://www.hra-decisiontools.org.uk/research/

Perhaps you could also contact the relevant R&D department for your project to inform them about your intended project and for their advice.

Kind regards
On behalf of South East Scotland Research Ethics Service

From: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Sent: 11 March 2021 15:49
To: sesres, <sesres@nhslothian.scot.nhs.uk>
Subject: Data Study Query

Dear Helen,

My name is Nicola McGuire and I am a PhD student at the University of Glasgow. I have been advised to contact you to query use of anonymous archival data for a data study and whether NHS ethical review is required.

The data was collected from NHS Lothian and sponsored by University of Edinburgh, and the end of study notification form has been submitted. The reference is REC: 17/SS/0116 in case it is helpful to you.

The data is held by University of Edinburgh in an anonymised format. I have attached here the data items that I would be requesting, but in short I would be interested in the use of anonymised archival demographic information, questionnaire and interview score data and the anonymised raw transcripts which would be coded to create an additional interview score. The overarching aim of this proposed study is to identify whether findings in an ongoing data study are replicable in a novel dataset.

Can you tell me whether REC ethical approval would be required? Of course if you need more information to assess please let me know.

Best Wishes,

Nicola McGuire (she/her)

University of Edinburgh communication

Nicola McGuire (PGR)

From: CAHSS Research ethics <Cahss.res.ethics@ed.ac.uk>
Sent: 05 May 2021 11:19
To: Nicola McGuire (PGR)
Cc: SCHWANNAUER Matthias; CAHSS Research ethics
Subject: RE: New Study Query

Hi Nicola

Thank you for contacting us about your research. As you are a student at the University of Glasgow, sponsorship and ethics review for your project should come from Glasgow.

You would then need to make a request to the relevant UoE School for access to the data, if it is not publically available. It should also be checked that participants in the first study were informed that their anonymised data was to be used in future research.

Hope this is helpful.

Best wishes, Carol

From: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Sent: 04 May 2021 16:47
To: CAHSS Research ethics <Cahss.res.ethics@ed.ac.uk>
Cc: SCHWANNAUER Matthias <M.Schwannauer@ed.ac.uk>
Subject: New Study Query

Hello,

My name is Nicola McGuire and I am a PhD student at the University of Glasgow. I have recently been in touch with Helen Newbery in relation to a new study query around the approvals processes which may be required, and she has advised that from a REC perspective no new approval is required but that I should check whether further sponsor approvals are necessary.

I am looking to undertake a study of archival data originally collected in NHS Lothian and sponsored by University of
Edinburgh. The data is held by University of Edinburgh in an anonymised format. I have attached here the original PIS and consent form along with the data items that I would be requesting, but in short I would be interested in the use of anonymised archival demographic information, questionnaire and interview score data and the anonymised raw transcripts which would be coded to create an additional interview score. The overarching aim of this proposed study is to identify whether findings in an ongoing data study are replicable in a novel dataset.

Can you tell me whether this study would be subject to further University of Edinburgh approval procedures, or if there are any specific channels I should go through to determine this?

Best Wishes,

Nicola

University of Glasgow ethics approval

Dear Professor Hamish McLeod

MVLS College Ethics Committee

Project Title *Exploring relationships between differing measures of metacognition and negative symptoms: a replication study*
200200132

The College Ethics Committee has reviewed your application and has agreed that there is no objection on ethical grounds to the proposed study.

We are happy therefore to approve the project, subject to the conditions below. Note the requirement for approvals around data governance.

- The dataset contains sensitive and protected data (gender, health status). It is recommended that all such projects have a DPIA completed and approved by the Data Protection Office.
- Project end date as stipulated in original application.
- The data should be held securely for a period of ten years after the completion of the research project, or for longer if specified by the research funder or sponsor, in accordance with the University's Code of Good Practice in Research: (http://www.gla.ac.uk/media/media_227599_en.pdf)
- The research should be carried out only on the sites, and/or with the groups defined in the application.
- The research is aligned with standard University of Glasgow Privacy Notice and Data Protection Impact Assessment.
- Any proposed changes in the protocol should be submitted for reassessment, except when it is necessary to change the protocol to eliminate hazard to the subjects or where the change involves only the administrative aspects of the project. The Ethics Committee should be informed of any such changes.
- You should submit a short end of study report within 3 months of completion.

Yours sincerely

Dr Terry Quinn

Terry Quinn
FESO, MD, FRCP, BSc (hons), MBChB (hons)
Senior Lecturer / Honorary Consultant

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New Lister Building, Glasgow Royal Infirmary
Glasgow
G31 2ER
terry.quinn@glasgow.gla.ac.uk
Tel – 0141 201 8519

University of Glasgow data protection office communication

Nicola McGuire (PGR)

From: Data Protection
Sent: 09 August 2021 12:21
To: Nicola McGuire (PGR)
Subject: RE: New Study Query

Hi Nicola,

In that case I suggest you write back to the Ethics Committee and let them know that we have confirmed no DPIA is needed due to the anonymous nature of the data. DPIAs are required for research involving identifiable and pseudonymised data on human data subjects but if it is truly anonymous then there is no need.

Hope that helps.

Best wishes,

Gemma

Gemma Tougher
Data Protection & Freedom of Information Office
University of Glasgow

The University of Glasgow, charity number SC004401

From: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Sent: 09 August 2021 12:08
To: Data Protection <dp@glasgow.ac.uk>
Subject: RE: New Study Query

Hi Gemma,

Yes it was yourself I chatted with before I'm glad you remember – yes the data is fully anonymised and delinked.

Best Wishes,

Nicola

From: Data Protection <dp@glasgow.ac.uk>
Sent: 09 August 2021 12:06
To: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Subject: RE: New Study Query

Hi Nicola,

Yes, I remember you asked about agreements required with third parties for accessing the data. At the time we advised that if the data you are accessing is truly anonymous then we didn't have any concerns about use from a data protection perspective.

Can you confirm that the data is fully anonymised?

Best wishes,

Gemma

From: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Sent: 09 August 2021 10:27
To: dp@gla.ac.uk
Subject: FW: New Study Query

Hello,

I am wondering if you can assist me – I know you are very busy at the moment and there is a significant turnaround time for DPIA assessment, and I wanted to check the implications this would have on my research.

I am a PhD student in my thesis pending period (submission date 17th September 2021). I have received ethical approval to analyse an archival dataset from University of Edinburgh which is completely anonymised and de-linked. I have only just realised now that the ethics committee send a letter on the research ethics system which gives greater detail than the approval email and it suggests that a DPIA should be completed for the study due to the use of sensitive and protected data (gender, health status). I have a DMP completed for my overall PhD which includes this study, and I can complete a DPIA from this and the information included in my methodology. Given my timeline I recognise that the four week advised turnaround might make it impossible to complete my PhD in time if I am unable to receive any data from UofE or begin any analysis prior to the DPIA being reviewed.

Can you confirm whether DPIA review is required prior to any analysis being completed? If so is there any way for the project to be reviewed more urgently in order to assist me in completing my PhD in time?

I previously contacted DP about this study (emails below), incase this is helpful in orienting you to the study – and if you need any further information from me please let me know.

Best Wishes,

Nicola

From: Data Protection <dp@glasgow.ac.uk>
Sent: 06 May 2021 12:38
To: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Subject: RE: New Study Query

Hi Nicola,

I have checked with the University's Contracts team and they have advised:

In context of anonymous data transfers, we would do whatever the custodian required. If they don't need an agreement, we wouldn't push for one

So I think this all depends on whether Edinburgh require an agreement to be put in place. If they haven't mentioned it then possibly it is not required but it might be worth double checking.

If the data is truly anonymous then we don't have any concerns about use from a data protection perspective.

Best wishes,

Gemma

Gemma Tougher
Data Protection & Freedom of Information Office
University of Glasgow

The University of Glasgow, charity number SC004401

From: Nicola McGuire (PGR) <n.mcguire.1@research.gla.ac.uk>
Sent: 05 May 2021 12:28
To: dp@gla.ac.uk
Subject: New Study Query

Hello,

My name is Nicola and I'm a final year PhD student. I am interested in conducting research using anonymised archival data from the University of Edinburgh. The data custodian has given me permission to use the data and agreed that I could be granted guest access to the remote University of Edinburgh one drive to process the data, avoiding the need for transfer. Can you tell me if this is sufficient or if any further agreements are required to be put in place?

Best Wishes,

Nicola

Appendix 24: Regression results for study 4

Table 1: Simple linear regression of relationship between negative symptoms and AAI classification Dataset I

Variable	β	SE	P value	Confint (2.75%)	Confint (97.5%)
Total Negative Symptoms	-3.100	4.085	0.456	-11.572	5.372
Expressive Deficits	-2.050	1.779	0.261	-5.738	1.638
Experiential Deficits	-1.100	2.087	0.603	-5.427	3.227
Total Metacognition	3.145	1.800	0.092	-0.547	6.837
Self-Reflectivity	**1.562**	**0.714**	**0.038**	**0.097**	**3.026**
Understanding Others' Minds	1.185	0.630	0.071	-0.108	2.478
Decentration	-0.025	0.360	0.944	-0.765	0.714
Mastery	0.424	0.512	0.415	-0.627	1.474
Reappraisal and Support Seeking Emotion Regulation Strategies	2.308	3.465	0.515	-5.077	9.692
Expressive Suppression Emotion Regulation Strategies	-0.417	3.919	0.917	-8.821	7.988

Confint: Confidence Interval

Table 2: Simple linear regression of relationship between negative symptoms and AAI classification Dataset II

Variable	β	SE	P value	Confint (2.75%)	Confint (97.5%)
Total Negative Symptoms	**-0.852**	**0.279**	**0.005**	**-1.422**	**-0.281**
Expressive Deficits	-0.284	0.3038	0.357	-0.905	0.336
Experiential Deficits	**-0.901**	**0.253**	**0.001**	**-1.419**	**-0.383**
Total Metacognition	**2.184**	**0.966**	**0.031**	**0.211**	**4.157**
Self-Reflectivity	**1.530**	**0.471**	**0.003**	**0.569**	**2.492**
Understanding Others' Minds	0.747	0.408	0.077	-0.086	1.580
Decentration	-0.126	0.193	0.520	-0.519	0.268
Mastery	0.032	0.228	0.888	-0.432	0.497
Reappraisal and Support Seeking Emotion Regulation Strategies	1.765	2.342	0.457	-3.011	6.542
Expressive Suppression Emotion Regulation Strategies	-1.104	1.635	0.505	-4.438	2.230

Confint: Confidence Interval

Table 3: Simple linear regression of relationship between negative symptoms and AAI classification in combined dataset

Variable	ß	SE	P value	Confint (2.75%)	Confint (97.5%)
Total Negative Symptoms	**-1.493**	**0.625**	**0.028**	**-2.806**	**-0.180**
Expressive Deficits	-0.162	0.772	0.836	-1.773	1.449
Experiential Deficits	-0.483	0.613	0.441	-1.762	0.797
Total Metacognition	**2.788**	**0.918**	**0.004**	**0.951**	**4.624**
Self-Reflectivity	**1.608**	**0.391**	**>0.001**	**0.826**	**2.391**
Understanding Others' Minds	0.956	0.343	0.007	0.270	1.641
Decentration	-0.028	0.185	0.882	-0.397	0.342
Mastery	0.251	0.248	0.315	-0.245	0.747
Reappraisal and Support Seeking Emotion Regulation Strategies	0.183	0.284	0.522	-0.388	0.755
Expressive Suppression Emotion Regulation Strategies	-0.202	0.285	0.482	-0.776	0.371

Confint: Confidence Interval

Table 4: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in Dataset I

Outcome	R^2	F	DF	p value	Predictor	ß	SE	p value	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	0.326	1.088	9	0.418	Attachment Classification	-2.072	6.021	0.739	-15.693	11.549
					Total Metacognition	-0.440	0.736	0.564	-2.104	1.224
					Reappraisal and Support Seeking ER Strategies	-0.501	0.521	0.361	-1.679	0.677
					Expressive Suppression ER Strategies	-0.835	0.425	0.081	-1.796	0.126
Expressive Deficits	0.372	1.335	9	0.329	Attachment Classification	-1.491	2.379	0.546	-6.873	3.891
					Total Metacognition	-0.144	0.291	0.632	-0.802	0.513
					Reappraisal and Support Seeking ER Strategies	-0.082	0.206	0.701	-0.547	0.384
					Expressive Suppression ER Strategies	-0.357	0.168	0.062	-0.737	0.023
Experiential Deficits	0.435	1.731	9	0.227	Attachment Classification	0.454	2.701	0.871	-5.670	6.578
					Total Metacognition	-0.211	0.331	0.539	-0.959	0.537
					Reappraisal and Support Seeking ER Strategies	-0.444	0.234	0.091	-0.973	0.086
					Expressive Suppression ER Strategies	**-0.454**	**0.191**	**0.042**	**-0.886**	**-0.022**

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation

Table 5: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in Dataset II

Outcome	R^2	F	DF	p value	Predictor	ß	SE	p value	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	0.312	2.725	24	0.053	**Attachment Classification**	**-0.736**	**0.315**	**0.028**	**-1.386**	**-0.087**
					Total Metacognition	-0.032	0.057	0.582	-0.150	0.086
					Reappraisal and Support Seeking ER Strategies	-0.026	0.027	0.350	-0.081	0.030
					Expressive Suppression ER Strategies	0.023	0.036	0.526	-0.051	0.098
Expressive Deficits	0.146	1.111	26	0.373	Attachment Classification	0.008	0.342	0.981	-0.696	0.712
					Total Metacognition	-0.081	0.060	0.188	-0.204	0.042
					Reappraisal and Support Seeking ER Strategies	-0.005	0.026	0.835	-0.059	0.048
					Expressive Suppression ER Strategies	0.051	0.035	0.159	-0.021	0.124
Experiential Deficits	**0.392**	**3.863**	**24**	**0.015**	**Attachment Classification**	**-0.865**	**0.280**	**0.005**	**-1.443**	**-0.287**
					Total Metacognition	>0.001	0.051	0.996	-0.105	0.105
					Reappraisal and Support Seeking ER Strategies	-0.036	0.024	0.144	-0.085	0.013
					Expressive Suppression ER Strategies	0.012	0.032	0.720	-0.055	0.078

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation

Table 6: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in combined dataset

Outcome	R^2	F	DF	p value	Predictor	ß	SE	p value	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	0.295	1.256	12	0.340	Attachment Classification	-1.031	0.900	0.274	-2.993	0.930
					Total Metacognition	-0.085	0.137	0.548	-0.384	0.214
					Reappraisal and Support Seeking ER Strategies	0.302	0.307	0.344	-0.366	0.970
					Expressive Suppression ER Strategies	0.281	0.337	0.421	-0.454	1.016
Expressive Deficits	0.226	0.656	9	0.638	Attachment Classification	-1.043	1.073	0.234	-3.471	1.384
					Total Metacognition	0.221	0.173	0.234	-0.171	0.612
					Reappraisal and Support Seeking ER Strategies	0.457	0.741	0.553	-1.219	2.132
					Expressive Suppression ER Strategies	0.716	0.717	0.344	-0.907	2.338
Experiential Deficits	0.147	0.519	12	0.724	Attachment Classification	-0.085	0.795	0.917	-1.819	1.649
					Total Metacognition	-0.168	0.152	0.289	-0.499	0.162
					Reappraisal and Support Seeking ER Strategies	0.134	0.285	0.647	-0.488	0.756
					Expressive Suppression ER Strategies	0.183	0.232	0.579	-0.517	0.884

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation

Table 7: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as subdomains) and emotion regulation in Dataset I

DV	R^2	F	DF	p value	Predictor	ß	SE	pvalue	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	**0.94**	**13.420**	**6**	**0.003**	Attachment Classification	4.996	2.499	0.093	-1.119	11.112
					Self-Reflectivity	-0.840	0.741	0.300	-2.653	0.972
					Understanding Others' Minds	**-4.713**	**1.140**	**0.006**	**-7.502**	**-1.925**
					Decentration	**8.870**	**2.116**	**0.006**	**3.692**	**14.046**
					Mastery	-1.894	1.847	0.345	-6.414	2.626
					Reappraisal and Support Seeking ER Strategies	**-0.586**	**0.192**	**0.023**	**-1.056**	**-0.116**
					Expressive Suppression ER Strategies	**-0.839**	**0.167**	**0.002**	**-1.249**	**-0.429**
Expressive Deficits	0.806	3.571	6	0.071	Attachment Classification	-0.212	1.837	0.912	-4.708	4.284
					Self-Reflectivity	-0.327	0.545	0.570	-1.659	1.006
					Understanding Others' Minds	-1.563	0.838	0.111	-3.613	0.487
					Decentration	0.558	1.556	0.732	-3.249	4.364
					Mastery	1.640	1.358	0.273	-1.683	4.963
					Reappraisal and Support Seeking ER Strategies	-0.087	0.141	0.562	-0.433	0.259
					Expressive Suppression ER Strategies	**-0.418**	**0.124**	**0.015**	**-0.719**	**-0.116**
Experiential Deficits	**0.835**	**4.327**	**6**	**0.047**	Attachment Classification	3.509	2.036	0.136	-1.474	8.492
					Self-Reflectivity	-0.078	0.603	0.902	-1.554	1.399
					Understanding Others' Minds	-2.123	0.929	0.062	-4.395	0.149
					Decentration	**4.359**	**1.724**	**0.045**	**0.140**	**8.577**
					Mastery	-1.834	1.505	0.269	-5.517	1.849
					Reappraisal and Support Seeking ER Strategies	**-0.494**	**0.157**	**0.020**	**-0.878**	**-0.111**
					Expressive Suppression ER Strategies	**-0.437**	**0.136**	**0.019**	**-0.771**	**-0.103**

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation

Table 8: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as subdomains) and emotion regulation in Dataset II

DV	R^2	F	DF	p value	Predictor	ß	SE	pvalue	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	0.420	2.171	21	0.080	**Attachment Classification**	**-1.004**	**0.351**	**0.009**	**-1.734**	**-0.275**
					Self-Reflectivity	0.282	0.193	0.158	-0.118	0.683
					Understanding Others' Minds	-0.353	0.219	0.122	-0.808	0.103
					Decentration	-0.357	0.288	0.229	-0.955	0.241
					Mastery	0.342	0.274	0.226	-0.228	0.913
					Reappraisal and Support Seeking ER Strategies	-0.028	0.027	0.303	-0.083	0.027
					Expressive Suppression ER Strategies	0.044	0.037	0.253	-0.034	0.122
Expressive Deficits	0.204	0.842	23	0.564	Attachment Classification	0.155	0.405	0.705	-0.683	0.993
					Self-Reflectivity	-0.168	0.210	0.414	-0.603	0.268
					Understanding Others' Minds	-0.029	0.241	0.905	-0.527	0.468
					Decentration	0.247	0.321	0.449	-0.417	0.912
					Mastery	-0.319	0.283	0.271	-0.904	0.266
					Reappraisal and Support Seeking ER Strategies	0.005	0.028	0.851	-0.052	0.063
					Expressive Suppression ER Strategies	0.044	0.037	0.238	-0.032	0.120
Experiential Deficits	**0.552**	**3.689**	**21**	**0.009**	**Attachment Classification**	**-1.182**	**0.292**	**>0.001**	**-1.789**	**-0.575**
					Self-Reflectivity	**0.348**	**0.160**	**0.042**	**0.014**	**0.681**
					Understanding Others' Minds	-0.332	0.182	0.083	-0.711	0.047
					Decentration	-0.436	0.239	0.083	-0.933	0.061
					Mastery	0.405	0.228	0.090	-0.069	0.880
					Reappraisal and Support Seeking ER Strategies	-0.040	0.022	0.086	-0.086	0.006
					Expressive Suppression ER Strategies	0.036	0.031	0.266	-0.029	0.101

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation

Table 9: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as subdomains) and emotion regulation in combined dataset

DV	R^2	F	DF	p value	Predictor	ß	SE	pvalue	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	0.586	1.821	9	0.198	Attachment Classification	-0.450	0.841	0.605	-2.354	1.423
					Self-Reflectivity	0.147	0.420	0.734	-0.803	1.098
					Understanding Others' Minds	0.225	0.273	0.432	-0.393	0.842
					Decentration	0.071	0.490	0.888	-0.393	0.842
					Mastery	-0.558	0.351	0.146	-1.038	1.181
					Reappraisal and Support Seeking ER Strategies	0.335	0.295	0.286	-0.333	1.003
					Expressive Suppression ER Strategies	0.459	0.332	0.201	-0.293	1.210
Expressive Deficits	0.466	0.749	6	0.646	Attachment Classification	-1.009	1.249	0.450	-4.066	2.047
					Self-Reflectivity	-0.469	1.219	0.714	-3.451	2.513
					Understanding Others' Minds	0.454	0.553	0.443	-0.900	1.808
					Decentration	1.404	0.833	0.143	-0.634	3.441
					Mastery	-0.527	0.708	0.485	-2.260	1.206
					Reappraisal and Support Seeking ER Strategies	0.237	1.006	0.822	-2.225	2.699
					Expressive Suppression ER Strategies	0.220	1.105	0.849	-2.485	2.925
Experiential Deficits	0.216	0.353	9	0.908	Attachment Classification	-0.052	0.923	0.956	-2.141	2.037
					Self-Reflectivity	-0.144	0.486	0.768	-1.221	0.932
					Understanding Others' Minds	-0.113	0.316	0.728	-0.828	0.601
					Decentration	-0.404	0.539	0.473	-1.623	0.816
					Mastery	-0.162	0.416	0.706	-1.103	0.779
					Reappraisal and Support Seeking ER Strategies	0.142	0.339	0.685	-0.624	0.909
					Expressive Suppression ER Strategies	0.296	0.390	0.466	-0.585	1.178

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation

Table 10: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in Dataset I with interaction terms added

DV	R^2	F	DF	p value	Predictor	β	SE	pvalue	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	0.653	1.614	6	0.288	Attachment Classification	-38.296	29.597	0.243	-110.717	34.125
					Total Metacognition	10.223	7.829	0.240	-5.958	29.405
					Reappraisal and Support Seeking ER Strategies	5.803	3.901	0.187	-3.742	15.348
					Expressive Suppression ER Strategies	-0.382	2.343	0.876	-6.114	5.350
					AAI and TMASA	2.757	2.138	0.245	-2.475	7.989
					TMASA and RSS ER Strategies Interaction	-0.517	0.300	0.136	-1.251	0.217
					TMASA and ES ER Strategies Interaction	-0.028	0.157	0.863	-0.411	0.355
Expressive Deficits	0.441	0.675	6	0.692	Attachment Classification	-8.469	15.390	0.994	-46.126	29.189
					Total Metacognition	1.018	4.076	0.811	-8.956	10.992
					Reappraisal and Support Seeking ER Strategies	0.747	2.028	0.725	-4.216	5.711
					Expressive Suppression ER Strategies	-0.498	1.218	0.697	-3.479	2.483
					AAI and TMASA	0.566	1.112	0.629	-2.154	3.287
					TMASA and RSS ER Strategies Interaction	-0.070	0.156	0.671	-0.451	0.312
					TMASA and ES ER Strategies Interaction	0.012	0.081	0.892	-0.188	0.211
Experiential Deficits	0.783	3.088	6	0.095	Attachment Classification	-11.487	11.502	0.357	-39.601	16.658
					Total Metacognition	4.050	3.046	0.232	-3.404	11.504
					Reappraisal and Support Seeking ER Strategies	2.176	1.516	0.201	-1.533	5.886
					Expressive Suppression ER Strategies	-0.642	0.910	0.507	-2.869	1.586
					AAI and TMASA	0.938	0.831	0.302	-1.095	2.971
					TMASA and RSS ER Strategies Interaction	-0.220	0.117	0.108	-0.506	0065
					TMASA and ES ER Strategies Interaction	0.012	0.061	0.851	-0.137	0.161

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation; **AAI:** Adult Attachment Interview; **TMASA:** Total Metacognition Assessment Scale – Adapted score; **RSS:** Reappraisal and Support Seeking; **ES:** Expressive Suppression

Table 11: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in Dataset II with interaction terms added

DV	R^2	F	DF	p value	Predictor	Β	SE	pvalue	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	0.374	1.792	21	0.142	Attachment Classification	-2.360	1.613	0.158	-5.714	0.994
					Total Metacognition	0.452	0.446	0.323	-0.476	1.380
					Reappraisal and Support Seeking ER Strategies	0.109	0.117	0.364	-0.135	0.353
					Expressive Suppression ER Strategies	0.175	0.212	0.418	-0.266	0.616
					AAI and TMASA	0.125	0.120	0.312	-0.126	0.375
					TMASA and RSS ER Strategies Interaction	-0.012	0.01	0.244	-0.033	0.008
					TMASA and ES ER Strategies Interaction	-0.014	0.018	0.445	-0.052	0.024
Expressive Deficits	0.197	0.805	23	0.592	Attachment Classification	-1.464	1.798	0.424	-5.184	2.255
					Total Metacognition	0.292	0.408	0.481	-0.551	1.136
					Reappraisal and Support Seeking ER Strategies	0.096	0.108	0.384	-0.128	0.321
					Expressive Suppression ER Strategies	0.172	0.213	0.429	-0.269	0.613
					AAI and TMASA	0.115	0.134	0.399	-0.162	0.393
					TMASA and RSS ER Strategies Interaction	-0.009	0.009	0.326	-0.027	0.009
					TMASA and ES ER Strategies Interaction	-0.011	0.019	0.546	-0.050	0.027
Experiential Deficits	0.439	2.350	21	0.061	Attachment Classification	-2.502	1.445	0.098	-5.506	0.502
					Total Metacognition	0.348	0.400	0.393	-0.482	1.179
					Reappraisal and Support Seeking ER Strategies	0.045	0.105	0.670	-0.173	0.264
					Expressive Suppression ER Strategies	0.150	0.190	0.439	-0.245	0.544
					AAI and TMASA	0.126	0.108	0.255	-0.098	0.350
					TMASA and RSS ER Strategies Interaction	-0.007	0.009	0.419	-0.0261	0.113
					TMASA and ES ER Strategies Interaction	-0.013	0.016	0.438	-0.047	0.021

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation; **AAI:** Adult Attachment Interview; **TMASA:** Total Metacognition Assessment Scale – Adapted score; **RSS:** Reappraisal and Support Seeking; **ES:** Expressive Suppression

Table 12: Multiple regression models exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in combined dataset with interaction terms added

DV	R^2	F	DF	p value	Predictor	Β	SE	pvalue	Confint (2.5%)	Confint (97.5%)
Total Negative Symptoms	0.527	1.435	9	0.300	Attachment Classification	-1.591	4.986	0.757	-12.870	9.688
					Total Metacognition	-0.090	0.150	0.563	-0.429	0.249
					Reappraisal and Support Seeking ER Strategies	2.083	2.409	0.410	-3.367	7.533
					Expressive Suppression ER Strategies	3.736	1.771	0.064	-0.271	7.743
					AAI and TMASA	0.019	0.332	0.957	-0.733	0.770
					TMASA and RSS ER Strategies Interaction	-0.170	0.237	0.491	-0.707	0.366
					TMASA and ES ER Strategies Interaction	-0.303	0.156	0.085	-0.656	0.051
Expressive Deficits	0.686	1.868	6	0.232	Attachment Classification	2.545	3.912	0.540	-7.027	12.116
					Total Metacognition	-0.034	0.251	0.898	-0.646	0.579
					Reappraisal and Support Seeking ER Strategies	**-13.443**	**5.444**	**0.049**	**-26.763**	**-0.124**
					Expressive Suppression ER Strategies	-5.598	2.861	0.098	-12.599	1.403
					AAI and TMASA	-0.192	0.304	0.551	-0.936	0.552
					TMASA and RSS ER Strategies Interaction	**1.242**	**0.477**	**0.040**	**0.076**	**2.409**
					TMASA and ES ER Strategies Interaction	0.564	0.237	0.055	-0.016	1.145
Experiential Deficits	0.267	0.469	9	0.835	Attachment Classification	-4.122	6.004	0.510	-17.704	9.460
					Total Metacognition	-0.244	0.183	0.214	-0.657	0.169
					Reappraisal and Support Seeking ER Strategies	1.283	2.367	0.601	-4.072	6.638
					Expressive Suppression ER Strategies	2.270	2.162	0.321	-2.622	7.162
					AAI and TMASA	0.271	0.422	0.537	-0.683	1.225
					TMASA and RSS ER Strategies Interaction	-0.112	0.231	0.638	-0.635	0.410
					TMASA and ES ER Strategies Interaction	-0.181	0.189	0.364	-0.608	0.247

DF: Degrees of Freedom, **SE:** Standard Error, **Confint:** Confidence Interval, **ER:** Emotion Regulation; **AAI:** Adult Attachment Interview; **TMASA:** Total Metacognition Assessment Scale – Adapted score; **RSS:** Reappraisal and Support Seeking; **ES:** Expressive Suppression

Table 13: Stepwise regression results exploring the relationship between negative symptoms, attachment classification, metacognition (treated as subdomains) and emotion regulation in Dataset I

Outcome	Self-Reflectivity	Understanding Others' Minds	Decentration	Mastery	Attachment Classification	RSS ER Strategies	ES ER Strategies
Total Negative Symptoms	6	2	1	7	5	4	3
Expressive Negative Symptoms	2	4	6	3	7	5	1
Experiential Negative Symptoms	7	3	4	6	5	2	1

RSS: Reappraisal and Support Seeking; **ES:** Expressive Suppression; **ER:** Emotion Regulation

Table 14: Stepwise regression results exploring the relationship between negative symptoms, attachment classification, metacognition (treated as subdomains) and emotion regulation in Dataset II

Outcome	Self-Reflectivity	Understanding Others' Minds	Decentration	Mastery	Attachment Classification	RSS ER Strategies	ES ER Strategies
Total Negative Symptoms	6	5	3	7	1	2	4
Expressive Negative Symptoms	3	7	4	1	5	6	2
Experiential Negative Symptoms	4	5	3	6	1	2	7

RSS: Reappraisal and Support Seeking; **ES:** Expressive Suppression; **ER:** Emotion Regulation

Table 15: Stepwise regression results exploring the relationship between negative symptoms, attachment classification, metacognition (treated as subdomains) and emotion regulation in combined dataset

Outcome	Self-Reflectivity	Understanding Others' Minds	Decentration	Mastery	Attachment Classification	RSS ER Strategies	ES ER Strategies
Total Negative Symptoms	6	2	7	1	5	4	3
Expressive Negative Symptoms	5	3	1	4	2	6	7
Experiential Negative Symptoms	2	6	3	1	7	5	4

RSS: Reappraisal and Support Seeking; **ES:** Expressive Suppression; **ER:** Emotion Regulation

Table 16: Stepwise regression results exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in Dataset I

Outcome	Total Metacognition	Attachment Classification	RSS ER Strategies	ES ER Strategies
Total Negative Symptoms	3	4	2	1
Expressive Deficits	3	2	4	1
Experiential Deficits	3	4	2	1

RSS: Reappraisal and Support Seeking; **ES:** Expressive Suppression; **ER:** Emotion Regulation

Table 17: Stepwise regression results exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in Dataset II

Outcome	Total Metacognition	Attachment Classification	RSS ER Strategies	ES ER Strategies
Total Negative Symptoms	4	1	2	3
Expressive Deficits	2	4	3	1
Experiential Deficits	4	1	2	3

RSS: Reappraisal and Support Seeking; **ES:** Expressive Suppression; **ER:** Emotion Regulation

Table 18: Stepwise regression results exploring the relationship between negative symptoms, attachment classification, metacognition (treated as total score) and emotion regulation in combined dataset

Outcome	Total Metacognition	Attachment Classification	RSS ER Strategies	ES ER Strategies
Total Negative Symptoms	4	1	2	3
Expressive Deficits	2	3	4	1
Experiential Deficits	1	4	3	2

RSS: Reappraisal and Support Seeking; **ES:** Expressive Suppression; **ER:** Emotion Regulation

Appendix 25: Path model fit statistics for combined datasets with MLR estimation for study 4

Table 6.5: Fit indices for path models estimated with MLR using combined dataset

Outcome	Model	Chi Square Statistic	DF	P-Value	CFI	AIC	RMSEA	CI Low	CI High	SRMR
Total Negative Symptoms	1	6.317	3	0.097	0.554	570.083	0.175	>0.001	0.368	0.108
	2	6.161	3	0.104	0.590	569.637	0.168	>0.001	0.358	0.109
	3	6.161	3	0.104	0.590	628.476	0.168	>0.001	0.358	0.109
Expressive Deficits	1	4.892	3	0.180	0.495	594.893	0.124	>0.001	0.314	0.088
	2	4.298	3	0.231	0.655	594.232	0.102	>0.001	0.299	0.086
	3	4.298	3	0.231	0.655	656.253	0.102	>0.001	0.299	0.086
Experiential Deficits	1	6.317	3	0.097	0.594	574.120	0.175	>0.001	0.368	0.110
	2	6.161	3	0.104	0.627	573.674	0.168	>0.001	0.358	0.112
	3	6.161	3	0.104	0.627	632.512	0.168	>0.001	0.358	0.112

CFI: Comparative Fit Index; **AIC:** Akaike Information Criterion; **RMSEA:** Root mean square error of approximation; **CI Low:** lower bound confidence interval; **CI High:** Upper bound confidence interval; **SRMR:** Standardised Root Mean Square Residual

Appendix 26: Impact of COVID-19 on thesis development and completion

One study intended for the purposes of this PhD (Investigating the impact of MEtacognitive Reflection and Insight Therapy on individual negative symptoms: A Single Case Experimental Design Study) was halted at the recruitment stage as infection control procedures prevented the ability of the protocol being completed as planned. As MEtacognitive and Reflective Insight Therapy (MERIT) has not been extensively evaluated as a therapy for negative symptoms specifically, the deviation required from the manualised treatment (Lysaker & Klion, 2017) to deliver this therapy via remote modalities (such as a telephone or digitial intervention) would have confounded results. Given that the intention of Single Case Experimental Design (SCED) methodology in this study was to explore in detail when and in what ways interventions are related to improvements in negative symptoms, this adaptation would not have satisfactorily fulfilled the study aims. Sufficient mitigation to complete this study was not possible in the remaining time to completion for the overall PhD due to continued infection control policies and the prevalence of COVID-19 impacting the ability to deliver therapy face to face.

A further study intended for the purposes of this PhD (Proof of concept: can Virtual Reality enhance metacognition in individuals with experiences of negative symptoms?) was in protocol development at the outset of the COVID-19 pandemic. This study was discontinued significant face to face contact and sharing of equipment would be required, which was identified as unlikely to be feasible as the longevity of infection control policies and continued high rates of COVID-19 infection became clear. The studies reported in chapter 5 and 6 were developed at this stage as part of COVID-19 mitigation plans for this PhD, as secondary data analysis was identified to be more feasible alongside mandates for home working.

The timeline of the PhD was impacted by the COVID-19 pandemic in several ways. The timescale for developing mitigation plans was impacted by increased demand on academic supervisors and organisational systems for seeking approval for data access and use. This delayed the overall timeline of the PhD. Ongoing work was also impacted by increased demands on all staff reducing capacity to

review work within pre-planned timelines. As a personal reflection from the author, the uncertainty and loss associated with making significant changes to the PhD projects and timeline, impacted my productivity and mood. This, coupled with additional strain as a carer and disruption to planned life events also contributed to the PhD timeline being delayed. As a result of all these factors incombination, the author was awarded and extension until February 2022.